NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: U.S. Army Corps of Engineers – New England District

Activity Considered: Issuance of a 10 Year Permit to Bath Iron Works for Maintenance Dredging at their Facility along the Kennebec River at Bath, Maine
F/NER/2009/04518

Conducted by: National Marine Fisheries Service
Northeast Region

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This constitutes NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Opinion) on the effects of the Army Corps of Engineers (ACOE) New England District's issuance of a permit to Bath Iron Works (BIW) for 10 years of maintenance dredging at their facility along the Kennebec River on threatened and endangered species in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This Opinion is based on information provided in the NMFS August 28, 1997 Opinion on dredging in the Kennebec River Federal Navigation Channel, the November 29, 2000 amendment to the 1997 Opinion, the April 16, 2002 Opinion on the dredging of the Kennebec River Federal Navigational Channel, the December 1, 2003 Opinion on the dredging of the Bath Iron Works Sinking Basin, the January 13, 2004 Opinion on the emergency dredging of the Kennebec River, the September 9, 2005 Opinion on the dredging of the Pier 3 berthing area, the October 10, 2007 Opinion on dredging of the Bath Iron Works Sinking Basin, information provided by the ACOE via letter dated July 9, 2009, correspondence with Mr. Jay Clement of the ACOE, and other sources of information. A complete administrative record of this consultation will be kept at the NMFS Northeast Regional Office. Formal consultation was initiated on July 14, 2009.

CONSULTATION HISTORY

In 1997, BIW began a project to construct a land level transfer facility (LLTF). The work proposed involved dredging the "inboard deck" and creation of a deep sinking basin for the dry dock, pile driving for "outboard deck", drilling/blasting/excavation in the landing grid and construction of landing grid blocks, dolphins, and anchor pads, in addition to shoreline improvements. In a June 10, 1998 letter NMFS concurred with the ACOE's determination that the proposed project was not likely to adversely affect shortnose sturgeon in the Kennebec River.

The ACOE , BIW and NMFS have been discussing a longterm approach to managing dredging activities at BIW since 2005. BIW routinely dredges three locations at their facility, the dry dock sinking basin, the landing grid, and the berth area (Piers 1, 2 and 3) and authorization for this dredging has occurred under a variety of permits issued by the ACOE and subject to consultation with NMFS. In a letter dated July 9, 2009, the ACOE requested initiation of consultation with NMFS on the ACOE's proposed authorization of a permit to authorize 10 years of maintenance dredging at the BIW facility. Upon review of this letter NMFS requested additional information to clarify the scope of the proposed action. NMFS received all of the information necessary to initiate consultation on July 14, 2009. As such, this date serves as the date of initiation of formal consultation. A brief history of previous consultations conducted between ACOE and NMFS regarding dredging activities at the BIW facility is provided below.

Dry Dock Sinking Basin
One component of the LLTF was the dry dock. Vessels on the dry dock are brought to the sinking basin where the dry dock is sunk so that the vessels are able to float off the dry dock. Construction of the sinking basin involved the removal of 500,000 cubic yards of material from the Kennebec River. The sinking basin is a 12.6 acre area adjacent to the BIW shipbuilding facility designed to have a depth of 70 feet below mean low water. The original dredging for the construction of the dry dock was completed between November 7, 1998 and January 5, 2000.

When originally constructed, BIW felt that the sinking basin hole would be self-scouring and would not require frequent dredging. In September 2001, the dry dock was not able to sink to design depths (-70' mean low water (MLW)). At that time it was not clear if sand came from a slump of the side walls or from infilling. Also in September 2001, dredging of the sinking basin to restore the 70' depth was completed under the terms of the permit issued by the ACOE in 1998 for the recently constructed LLTF.

In January 2002, BIW submitted an application to the ACOE for annual maintenance dredging of the sinking basin. The permit authorized the dredging of approximately 10,000 cubic yards (cy) of sandy sediment annually over a ten-year period. Material was to be removed by a clam-shell bucket dredge mounted on a barge and would be disposed of in an established disposal area in the Kennebec River, north of Bluff Head in approximately 98 feet of water. The ACOE intended to include a permit condition allowing dredging to occur from November 1 – April 30 of each year.

In March 2002, the ACOE contacted NMFS regarding the proposed permit for maintenance dredging of the sinking basin. At this time, NMFS told the ACOE that shortnose sturgeon are known to be in the vicinity of the BIW facility year-round but that concentrations of shortnose sturgeon would be largest from the late spring to early fall. At this time there was no evidence that shortnose sturgeon would be adversely affected by mechanical dredging. The ACOE implemented a condition in the permit that restricted dredging to occur only from November 1 – April 30 of any year. In a letter dated May 24, 2002, NMFS concurred with the ACOE's determination that shortnose sturgeon were not likely to be adversely affected by the dredging activities in the sinking basin.

Dredging next occurred at the sinking basin between April 7 and April 30, 2003, with approximately 7,870 cubic yards of material removed. On April 30, 2003 the ACOE contacted NMFS to report that a shortnose sturgeon was killed by the mechanical dredge being used to dredge the sinking basin. This was the first evidence of lethal interactions between shortnose sturgeon and mechanical dredges. When the interaction occurred, NMFS told ACOE that any future dredging of the sinking basin with a mechanical dredge would require that the March 2002 consultation on this action be reinitiated as the take represented new information on the effects of the action.

In a conference call on September 5, 2003 between BIW staff, Jay Clement of the ACOE and Julie Crocker of NMFS, BIW indicated that it would be necessary to dredge the sinking basin before February 2004 as there was a US Navy destroyer scheduled for launching from the dry dock at that time and that recent sounding data had indicated that the sinking basin did not have adequate depth for the ship to float off the dry dock. BIW staff indicated that the dredging of 10-20,000cy of material would provide enough depth for the launch of this destroyer. The dredging of 79,300cy of material would bring the sinking basin back to its design depth of 70 feet below MLW and ensure that no maintenance dredging would be required before 2007. Consultation on the effects of the maintenance dredging of the sinking basin in the fall of 2003 was completed with the issuance of an Opinion dated December 1, 2003. Approximately 44,000 cubic yards of material were removed with dredging occurring 24 hours a day between December 14 and December 24. No interactions with shortnose sturgeon were observed.

Dredging of the sinking basin last occurred in December 2007. Approximately 70,000 cubic yards of silt were removed. Dredging took approximately 25 days to complete with dredging occurring 24 hours a day. Consultation with NMFS on the effects of this dredging was completed with the issuance of an Opinion dated October 5, 2007. Consultation was reinitiated in December 2007 due to a modification to the proposed action. A new Opinion was issued on January 16, 2008. No interactions with shortnose sturgeon were observed.

Berthing Piers
In 1997, BIW applied for ACOE and Maine Department of Environmental Protection (DEP) authorization to conduct maintenance dredging activities at their facility. The ACOE subsequently issued a permit (No. 199702110) for dredging along the various wharves and berthing areas located on the west bank of the Kennebec River. All dredging was to be done with a mechanical dredge with upland disposal. Ten years of maintenance dredging was also authorized by the permit. No consultation pursuant to section 7 of the ESA was conducted between ACOE and NMFS on the issuance of this permit by the ACOE. The permit issued by the DEP required that an endangered species observer be present on the dredge barge if dredging occurred from April 2 through October 31 of any year. Dredging occurred in 1997 and no interactions with endangered species were recorded.

In April 2005, BIW informed the ACOE that they would be dredging the Pier 3 berthing area (also referred to as the outfitting pier) in June 2005 as there were not adequate depths present at the berthing area for a US Navy Destroyer to be moved to Pier 3. Design depths at Pier 3 are 32 feet below mean low water. At that time, the ACOE contacted NMFS and inquired as to what steps were necessary to ensure that consultation was complete for the proposed dredging. In correspondence between Jay Clement of the ACOE and Sara McNulty of NMFS, NMFS indicated that as shortnose sturgeon are known to be present in the area to be dredged during the time of year proposed for dredging and shortnose sturgeon have been documented to be killed by mechanical dredge operations, section 7 consultation was necessary. NMFS indicated and ACOE agreed that formal consultation was necessary for the action proposed by ACOE.

In a letter dated May 2, 2005 the ACOE requested formal consultation for the proposed dredging of approximately 2000 cubic yards (cy) of silt material from the BIW pier 3 berthing area so that adequate depths would be present for the docking of a US Navy Destroyer on June 6, 2005. However, subsequent soundings conducted by BIW indicated that natural scouring had removed enough silt for the ship to dock safely. Soundings conducted throughout the summer of 2005 indicated that dredging would be necessary to deberth the ship in October. As such, BIW sought approval from the ACOE to conduct the required dredging in September 2005. In an e-mail dated August 29, 2005 ACOE informed NMFS that BIW had requested to dredge an additional 9,000 cy of material from the pier 3 berthing area beginning November 1, 2005. ACOE indicated to NMFS that they intended to approve this request. Approximately 2,000 cy of silt was removed over a 10 day period beginning on September 19, 2005. An additional 9,000 cy of material was removed over approximately 6 weeks between November and December 2005. No interactions with listed species occurred during these dredging operations.

Pier 3 was last dredged in June 2009. In May 2009, BIW requested authorization from the ACOE to conduct maintenance dredging sufficient to remove approximately 1,260 cubic yards of sand and silt from an 8,000 square foot area within the Pier 3 berthing area along the shoreline of the Kennebec River. Consultation with NMFS was completed with the issuance of letter dated May 26, 2009 in which NMFS concurred with the ACOE's determination that the proposed action was not likely to adversely affect any listed species. This conclusion was based on the small volume of material to be removed, the short duration of the project, and the inclusion of a requirement that dredging cease should total suspended solids levels rise to 50mg/L above background. Dredging began on June 1, 2009 and was expected to last 5-10 days. However, on the afternoon of June 1, the endangered species observer saw a 75cm shortnose sturgeon in the scow where dredged material was being deposited. The fish was not submerged underwater but resting on top of a pile of woody debris. The fish was retrieved from the scow and returned to the river without injury. Dredging ceased and was not resumed.

Landing Grid

BIW's dry dock is kept on Landing Grid 1 when not in use. Landing Grid 1 was last dredged in 2004 as permitted by ACOE in the 10 year maintenance dredging condition in the LLTF construction permit. Approximately 2,000 to 4,000 cy of material was removed during this dredging event. No shortnose sturgeon interactions were recorded during this event. Dredging at the landing grid was last completed in January 2008, with approximately 1200 cy removed from the grid area. No interactions with listed species were recorded during this event. Consideration of the effects of the dredging of the landing grid was included in the Opinion issued by NMFS to

ACOE dated January 16, 2008 referenced above.

DESCRIPTION OF THE PROPOSED ACTION

Maintenance dredging at the BIW facility is necessary to accommodate the launching, berthing, and maintenance of deep draft vessels. There are several areas which are routinely dredged; these include the landing grid, sinking basin, and berthing piers (see site map in Appendix A). ACOE proposes to authorize BIW to dredge each of these areas with a clamshell bucket controlled by a barge mounted crane. The proposed permit would authorize maintenance dredging between October 1 and May 31 of any year, beginning in 2009. The permit will expire 10 years from its issuance (2019). BIW and ACOE have proposed the following schedule for maintenance dredging:

- Dry Dock Sinking Basin: Remove 70,000 cy of material in the Fall of 2009, with maintenance dredging of up to 70,000 cy occurring every three years for a total of four dredge events over the life of the permit;
- Landing Grid: Remove 3,500 cy of material from Landing Grid 1 in the Fall of 2009 with maintenance dredging of up to 4,000 cy occurring every four years for a total of three dredge events over the life of the permit;
- Berthing Piers: Remove up to 4,000 cy of material from the Pier 3 area in the Fall of 2009 with maintenance dredging of up to 4,000 cy occurring every four years for a total of three dredge events over the life of the permit.

All dredging will occur with a mechanical clamshell dredge. As noted above, all dredging will occur between October 1 and May 31. Dredging at the sinking basin could take up to 6 weeks with dredging at the landing grid and berthing piers expected to take 2-3 weeks each. In 2009, all three locations will be dredged. However, this is not expected to occur in subsequent years. Also in 2009, two dredges will be used. One dredge will be used at the sinking basin with the other working at the landing grid and berthing piers. In future years, simultaneous dredging of multiple sites is not expected to occur. Dredging at the sinking basin may occur 24 hours a day. Dredging at the landing grid and berthing piers will be restricted to daylight hours, and depending on the time of year, may occur 8-12 hours a day. Subsequent to 2009, the following maintenance dredging events are currently predicted: 2012 (sinking basin only); 2013 (landing grid and berthing piers); 2015 (sinking basin); 2017 (landing grid and berthing piers); and, 2018 (sinking basin).

The ACOE will implement a special permit condition requiring that for any dredging occurring at the time of year when Atlantic salmon are likely to be present in the action area (i.e., April 10 – November 7), total suspended solids (TSS) levels be monitored continuously throughout dredging. The monitoring location must be located 50 meters up and down stream from the dredge with monitoring alternating hourly between the up and down stream location. Further, the ACOE will require that should TSS levels of 50mg/L above background be detected at the monitoring location, dredging must cease until TSS levels return to background levels.

Disposal of Dredged Material
The location at which dredged material will be disposed is dependent on the location of the dredging activity. Historic sampling and testing has shown that the material to be removed is clean sand suitable for in-river or nearshore disposal. Material dredged from the sinking basin will be disposed of at the previously used in-river disposal area north of Bluff Head in approximately 95-100 feet of water. Disposal at this site has been recommended by the Maine Geological Survey to help maintain the sand balance in the Kennebec River system. Material dredged from the other locations will be disposed of at an upland location. For these dredging operations, material will be loaded into scows then towed to a nearby dock where it will be offloaded into dump trucks and trucked to a disposal facility.

As noted above, in 2009, dredging will occur at the sinking basin as well as the landing grid and berthing pier 3. Material from the sinking basin will be disposed of at the in river disposal site near Bluff Head. Material from the landing grid and berthing pier 3 will be disposed of at an upland location. Future maintenance dredging at the sinking basin will also result in in-water disposal. However, the ACOE will implement a permit condition requiring that should in-water disposal be carried out between April 10 – May 31 or October 1 – November 7 (i.e., the time of year when Atlantic salmon would be present in the action area), a dredged material management plan must be developed. This plan would be developed by BIW in coordination with ACOE and NMFS and would require monitoring of disposal operations and restrictions on disposal such that disposal would cease should TSS levels greater than 50mg/L above background be recorded. Disposal could only resume once TSS levels returned to background.

Action Area
The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the area to be dredged (i.e., the 12.6 acre sinking basin, the adjacent landing grid, and the berthing area) as well as the area of the Kennebec River where increased suspended sediment will be present due to the removal of silt. Based on analysis of other mechanical dredging activities (Burton 1993; Normandeau 2001; U. Washington 2001), increased suspended sediment levels are likely to be present for no more than 3300-feet downstream of the dredge area. The direction of the sediment plume will change based on the tides. As such, the action area is considered to be that area of the Kennebec River located within a 3300-foot radius from the area to be dredged. Additionally, the action area will include the Bluffs Head disposal site and the transit route to and from the disposal site as well as an area extending 3000-feet from the disposal area where increased levels of suspended sediment are likely to be experienced. The action area also includes the transit route to the nearby dock where material from the berthing area and landing grid will be towed and then removed by truck. This area is expected to encompass all of the direct and indirect effects of the proposed dredging project (see map in Appendix A).

LISTED SPECIES IN THE ACTION AREA
This section will focus on the status of the species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

Two species listed under NMFS' jurisdiction are likely to occur in the action area for this consultation. Endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic salmon (*Salmo salar*) have been documented in the action area for this consultation. Additionally, the action area has been designated as critical habitat for GOM DPS Atlantic salmon. Several species of listed sea turtles and whales occur seasonally off the coast of Maine. However, as the action area is located within the Kennebec River where no whales or sea turtles occur, no whale or sea turtle species will be further discussed in this Opinion.

STATUS OF AFFECTED SPECIES

NMFS has determined that the action being considered in this biological opinion may affect the following endangered or threatened species under NMFS' jurisdiction:

Fish

Gulf of Maine Distinct Population Segment of Atlantic Salmon	Endangered
Shortnose sturgeon	Endangered

This section will focus on the status of these species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

Gulf of Maine DPS of Atlantic Salmon

The Atlantic salmon is an anadromous fish species that spends most of its adult life in the ocean but returns to freshwater to reproduce. The Atlantic salmon is native to the basin of the North Atlantic Ocean, from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from the Ungava region of northern Quebec south to the Connecticut River (Scott and Crossman 1973). In the United States, Atlantic salmon historically ranged from Maine south to Long Island Sound. However, the Central New England DPS and Long Island Sound DPS have both been extirpated (65 FR 69459; Nov. 17, 2000).

The GOM DPS of anadromous Atlantic salmon was initially listed by the USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). A subsequent re-listing as an endangered species by the Services (74 FR 29344; June 19, 2009), included an expanded range for the GOM DPS of Atlantic salmon. The decision to expand the geographic range of the GOM DPS was largely based on the results of a Status Review (Fay *et al.* 2006) completed by a Biological Review Team consisting of federal and state agencies and Tribal interests. Fay *et al.* (2006) concluded that the DPS delineation in the 2000 listing designation was largely appropriate, except in the case of large rivers that were excluded in the 2000 listing determination. Fay *et al.* (2006) concluded that the salmon currently inhabiting the larger rivers (Androscoggin, Kennebec, and Penobscot) are genetically similar to the rivers included in the GOM DPS as listed in 2000, have similar life history characteristics, and/or occur in the same zoogeographic region. Further, the salmon populations inhabiting the large and small rivers from the Androscoggin River northward to the Dennys River differ genetically and in important life history characteristics from Atlantic salmon in adjacent portions of Canada (Spidle *et al.* 2003; Fay *et al.* 2006). Thus, Fay *et al.* (2006) concluded that this group of populations (a "distinct population segment") met both the discreteness and significance criteria of the Services' DPS Policy (61 FR 4722; Feb. 7, 1996) and, therefore, recommended the geographic range included in the new expanded GOM DPS.

The newly listed GOM DPS includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. The following impassable falls delimit the upstream extent of the freshwater range: Rumford Falls in the town of Rumford on the Androscoggin River; Snow Falls in the town of West Paris on the Little Androscoggin River; Grand Falls in Township 3 Range 4 BKP WKR on the Dead River in the Kennebec Basin; the un-named falls (impounded by Indian Pond Dam) immediately above the Kennebec River Gorge in the town of Indian Stream Township on the Kennebec River; Big Niagara Falls on Nesowadnehunk Stream in Township 3 Range 10 WELS in the Penobscot Basin; Grand Pitch on Webster Brook in Trout Brook Township in the Penobscot Basin; and Grand Falls on the Passadumkeag River in Grand Falls Township in the Penobscot Basin. The marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland.

Included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at Green Lake National Fish Hatchery (GLNFH) and Craig Brook National Fish Hatcheries (CBNFH), both operated by the USFWS. Excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry (74 FR 29344; June 19, 2009).

Species Description
Atlantic salmon have a complex life history that includes territorial rearing in rivers to extensive feeding migrations on the high seas. During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Adult Atlantic salmon return to rivers from the sea and migrate to their natal stream to spawn. Adults ascend the rivers within the GOM DPS beginning in the spring. The ascent of adult salmon continues into the fall. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July (Meister 1958; Baum 1997). Early migration is an adaptive trait that ensures adults have sufficient time to effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Salmon that return in early spring spend nearly 5 months in the river before spawning, often seeking cool water refuge (e.g., deep pools, springs, and mouths of smaller tributaries) during the summer months.

In the fall, female Atlantic salmon select sites for spawning. Spawning sites are positioned within flowing water, particularly where upwelling of groundwater occurs, allowing for percolation of water through the gravel (Danie et al. 1984). These sites are most often positioned at the head of a riffle (Beland et al. 1982); the tail of a pool; or the upstream edge of a gravel bar where water depth is decreasing, water velocity is increasing (McLaughlin and Knight 1987; White 1942), and hydraulic head allows for permeation of water through the redd (a gravel depression where eggs are deposited). Female salmon use their caudal fin to scour or dig redds. The digging behavior also serves to clean the substrate of fine sediments that can embed the cobble/gravel substrate needed for spawning and consequently reduce egg survival (Gibson 1993). As the female deposits eggs in the redd, one or more males fertilize the eggs (Jordan and Beland 1981). The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel.

A single female may create several redds before depositing all of her eggs. Female anadromous Atlantic salmon produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per 2 sea-winter (SW) female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, Atlantic salmon may either return to sea immediately or remain in freshwater until the following spring before returning to the sea (Fay et al. 2006). From 1967 to 2003, approximately 3 percent of the wild and naturally reared adults that returned to rivers where adult returns are monitored--mainly the Penobscot River--were repeat spawners (USASAC 2004).

Embryos develop in the redd for a period of 175 to 195 days, hatching in late March or April (Danie et al. 1984). Newly hatched salmon referred, to as larval fry, alevin, or sac fry, remain in the redd for approximately 6 weeks after hatching and are nourished by their yolk sac (Gustafson-Greenwood and Moring 1991). Survival from the egg to fry stage in Maine is estimated to range from 15 to 35 percent (Jordan and Beland 1981). Survival rates of eggs and larvae are a function of stream gradient, overwinter temperatures, interstitial flow, predation, disease, and competition (Bley and Moring 1988). Once larval fry emerge from the gravel and begin active feeding they are referred to as fry. The majority of fry (>95 percent) emerge from redds at night (Gustafson-Marjanen and Dowse 1983).

When fry reach approximately 4 cm in length, the young salmon are termed parr (Danie et al., 1984). Parr have eight to eleven pigmented vertical bands on their sides that are believed to serve as camouflage (Baum 1997). A territorial behavior, first apparent during the fry stage, grows more pronounced during the parr stage, as the parr actively defend territories (Allen 1940; Kalleberg 1958; Danie et al. 1984). Most parr remain in the river for 2 to 3 years before undergoing smoltification, the process in which parr go through physiological changes in order to transition from a freshwater environment to a saltwater marine environment. Some male parr may not go through smoltification and will become sexually mature and participate in spawning with sea-run adult females. These males are referred to as "precocious parr."

First year parr are often characterized as being small parr or 0+ parr (4 to 7 cm long), whereas second and third year parr are characterized as large parr (greater than 7 cm long) (Haines 1992). Parr growth is a function of water temperature (Elliott 1991); parr density (Randall 1982); photoperiod (Lundqvist 1980); interaction with other fish, birds, and mammals (Bjornn and Resier 1991); and food supply (Swansburg et al. 2002). Parr movement may be quite limited in the winter (Cunjak 1988; Heggenes 1990); however, movement in the winter does occur (Hiscock et al. 2002) and is often necessary, as ice formation reduces total habitat availability

(Whalen et al. 1999). Parr have been documented using riverine, lake, and estuarine habitats; incorporating opportunistic and active feeding strategies; defending territories from competitors including other parr; and working together in small schools to actively pursue prey (Gibson 1993; Marschall et al. 1998; Pepper 1976; Pepper et al. 1984; Hutchings 1986; Erkinaro et al. 1998; Halvorsen and Svenning 2000; Hutchings 1986; O'Connell and Ash 1993; Erkinaro et al. 1995; Dempson et al. 1996; Halvorsen and Svenning 2000; Klemetsen et al. 2003).

In a parr's second or third spring (age 1 or age 2 respectively), when it has grown to 12.5 to 15 cm in length, a series of physiological, morphological, and behavioral changes occur (Schaffer and Elson 1975). This process, called "smoltification," prepares the parr for migration to the ocean and life in salt water. In Maine, the vast majority of naturally reared parr remain in freshwater for 2 years (90 percent or more) with the balance remaining for either 1 or 3 years (USASAC 2005). In order for parr to undergo smoltification, they must reach a critical size of 10 cm total length at the end of the previous growing season (Hoar 1988). During the smoltification process, parr markings fade and the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts in Maine range in size from 13 to 17 cm, and most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). During this migration, smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and predator assemblages. The physiological changes that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that come with the transition from a fresh to a salt water habitat (Ruggles 1980; Bley 1987; McCormick and Saunders 1987; McCormick et al. 1998). The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary. Given that smolts undergo smoltification while they are still in the river, they are pre-adapted to make a direct entry into seawater with minimal acclimation (McCormick et al. 1998). This pre-adaptation to seawater is necessary under some circumstances where there is very little transition zone between freshwater and the marine environment.

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004, 2005). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004, 2005). Lacroix and McCurdy (1996), however, found that post-smolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen et al. 2006; Lacroix and McCurdy 1996; Lacroix et al. 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post-smolts appear to have a more near-shore distribution (Friedland et al. 2003). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) and/or the major surface-current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton et al. 1997).

During the late summer and autumn of the first year, North American post-smolts are concentrated in the Labrador Sea and off of the west coast of Greenland, with the highest concentrations between 56 °N. and 58°N. (Reddin 1985; Reddin and Short 1991; Reddin and Friedland 1993). The salmon located off Greenland are composed of both 1SW fish and fish that have spent multiple years at sea (multi-sea winter fish, or MSW) and includes immature salmon from both North American and European stocks (Reddin 1988; Reddin et al. 1988). The first winter at sea regulates annual recruitment, and the distribution of winter habitat in the Labrador Sea and Denmark Strait may be critical for North American populations (Friedland et al. 1993). In the spring, North American post-smolts are generally located in the Gulf of St. Lawrence, off the coast of Newfoundland, and on the east coast of the Grand Banks (Reddin 1985; Dutil and Coutu 1988; Ritter 1989; Reddin and Friedland 1993; and Friedland et al. 1999).

Some salmon may remain at sea for another year or more before maturing. After their second winter at sea, the salmon over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found non-maturing adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

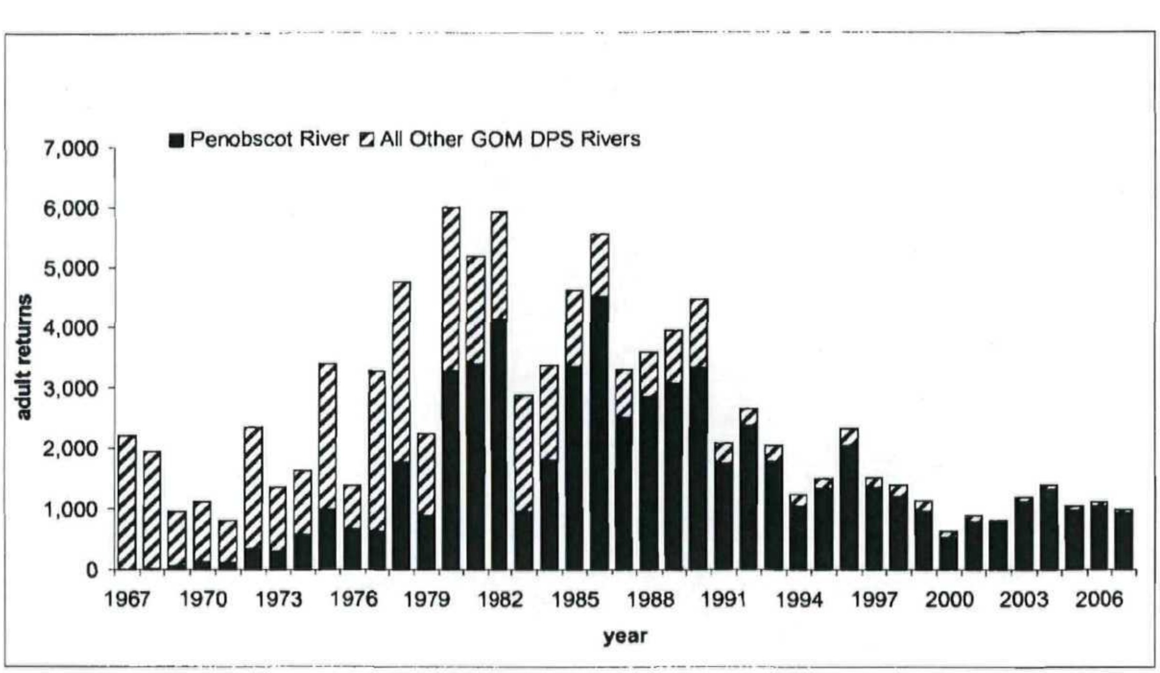
Status and Trends of Atlantic Salmon Rangewide

The abundance of Atlantic salmon within the range of the GOM DPS has been generally declining since the 1800s (Fay *et al.* 2006). Data sets tracking adult abundance are not available throughout this entire time period; however, Fay *et al.* (2006) present a comprehensive time series of adult returns to the GOM DPS dating back to 1967. It is important to note that contemporary abundance levels of Atlantic salmon within the GOM DPS are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas contemporary estimates of abundance for the entire GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay et al. 2006).

Contemporary abundance estimates are informative in considering the conservation status of the GOM DPS today. After a period of population growth in the 1970s, adult returns of salmon in the GOM DPS have been steadily declining since the early 1980s and appear to have stabilized at very low levels since 2000 (Figure 2). The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from GLNFH that was constructed in 1974. Marine survival remained relatively high throughout the 1980s, and salmon populations in the GOM DPS remained relatively stable until the early 1990s. In the early 1990s marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s. Poor marine survival persists in the GOM DPS to date.

Adult returns to the GOM DPS have been very low for many years and remain extremely low in terms of adult abundance in the wild. Further, the majority of all adults in the GOM DPS return to a single river, the Penobscot, which accounted for 91 percent of all adult returns to the GOM

Figure 1. Adult returns to the GOM DPS 1967-2007.



DPS in 2007. Of the 1044 adult returns to the Penobscot in 2006, 996 of these were the result of smolt stocking and only the remaining 48 were naturally-reared. The term naturally-reared includes fish originating from natural spawning and from hatchery fry (USASAC 2008). Hatchery fry are included as naturally-reared because hatchery fry are not marked; therefore, they cannot be distinguished from fish produced through natural spawning. Because of the extensive amount of fry stocking that takes place in an effort to recover the GOM DPS, it is possible that a substantial number of fish counted as naturally-reared were actually hatchery fry.

Low abundances of both hatchery-origin and naturally-reared adult salmon returns to Maine demonstrate continued poor marine survival. Declines in hatchery-origin adult returns are less sharp because of the ongoing effects of hatcheries. In short, hatchery production over this time period has been relatively constant, generally fluctuating around 550,000 smolts per year (USASAC 2008). In contrast, the number of naturally reared smolts emigrating each year is likely to decline following poor returns of adults (three years prior). Although it is impossible to distinguish truly wild salmon from those stocked as fry, it is likely that some portion of naturally reared adults are in fact wild. Thus, wild smolt production would suffer three years after a year with low adult returns, because the progeny of adult returns typically emigrate three years after their parents return. The relatively constant inputs from smolt stocking, coupled with the declining trend of naturally reared adults, result in the apparent stabilization of hatchery-origin salmon and the continuing decline of naturally reared components of the GOM DPS observed over the last two decades.

Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE) goals that are widely used (ICES 2005) to describe the status of individual Atlantic salmon populations. When CSE goals are met, Atlantic salmon populations are generally self-sustaining. When CSE goals are not met (i.e., less than 100 percent), populations are not reaching full potential; and this can be indicative of a population decline. For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status.

In conclusion, the abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 10%) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS.

Critical Habitat

Coincident with the June 19, 2009 endangered listing, NMFS designated critical habitat for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009) (Figure 3). Designation of critical habitat is focused on the known primary constituent elements (PCEs) within the occupied areas of a listed species that are deemed essential to the conservation of the species. Within the GOM DPS, the PCEs for Atlantic salmon are 1) sites for spawning and rearing and 2) sites for migration (excluding marine migration[1]). NMFS chose not to separate spawning and rearing habitat into distinct PCEs, although each habitat does have distinct features, because of the GIS-based habitat prediction model approach that was used to designate critical habitat (74 FR 29300; June 19, 2009). This model cannot consistently distinguish between spawning and rearing habitat across the entire range of the GOM DPS.

The physical and biological features of the two PCEs for Atlantic salmon critical habitat are as follows:

<u>Physical and Biological Features of the Spawning and Rearing PCE[2]</u>

A1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.

A2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.

A3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.

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1 Although successful marine migration is essential to Atlantic salmon, NMFS was not able to identify the essential features of marine migration and feeding habitat or their specific locations at the time critical habitat was designated.
2 Appendix A designates the seven physical and biological features of the spawning and rearing PCE as A1 – A7. That convention will be used throughout this opinion.

A4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.

A5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production.

A6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.

A7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

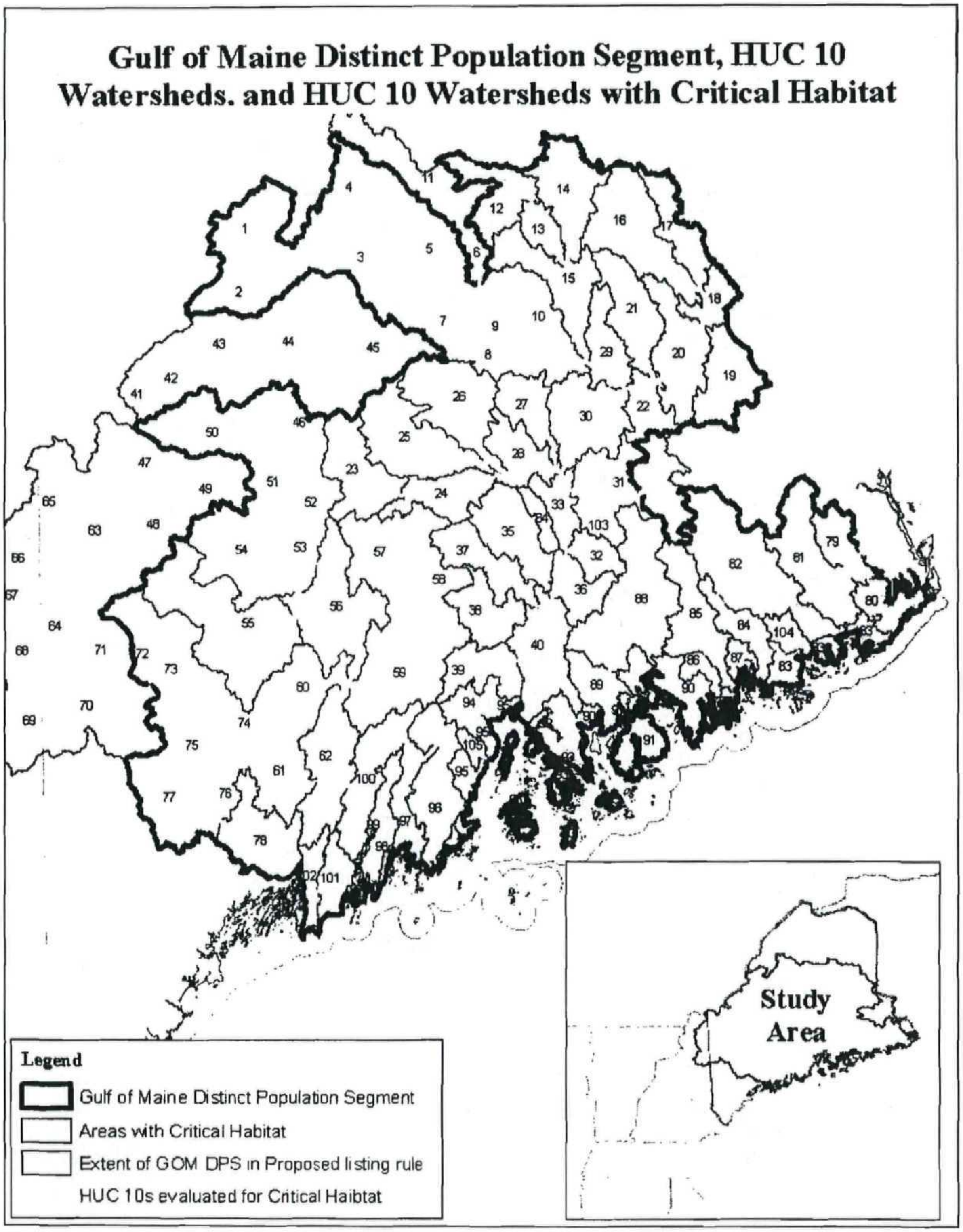

Figure 2. HUC 10 watersheds designated as Atlantic salmon critical habitat within the GOM DPS.

Physical and Biological Features of the Migration PCE[3]

B1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations.

B2. Freshwater and estuary migration sites with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon.

B3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.

B4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

B5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration

B6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Habitat areas designated as critical habitat must contain one or more PCEs within the acceptable range of values required to support the biological processes for which the species uses that habitat. Critical habitat includes all perennial rivers, streams, and estuaries and lakes connected to the marine environment within the range of the GOM DPS, except for those areas that have been specifically excluded as critical habitat. Critical habitat has only been designated in areas considered currently occupied by the species. Critical habitat includes the stream channels within the designated stream reach and includes a lateral extent as defined by the ordinary high-water line or the bankfull elevation in the absence of a defined high-water line. In estuaries, critical habitat is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

For an area containing PCEs to meet the definition of critical habitat, the ESA also requires that the physical and biological features essential to the conservation of Atlantic salmon in that area "may require special management considerations or protections." Activities within the GOM DPS that were identified as potentially affecting the physical and biological features and therefore requiring special management considerations or protections include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road crossings, mining, dams, dredging, and aquaculture.

Salmon Habitat Recovery Units within Critical Habitat for the GOM DPS

In describing critical habitat for the Gulf of Maine DPS, NMFS divided the GOM DPS into three Salmon Habitat Recovery Units or SHRUs. The three SHRUs include the Downeast Coastal, Penobscot Bay, and Merrymeeting Bay. The SHRU delineations were designed by NMFS to ensure that a recovered Atlantic salmon population has widespread geographic distribution to

3 Appendix A designates the six physical and biological features of the migration PCE as B1-B6. That convention will be used throughout this opinion.

help maintain genetic variability and, therefore, a greater probability of population sustainability in the future. Areas designated as critical habitat within each SHRU are described in terms of habitat units. One habitat unit represents 100 m^2 of suitable salmon habitat (which could be spawning and rearing habitat or migration habitat). Habitat units within the GOM DPS were estimated through the use of a GIS-based salmon habitat model (Wright *et al.* 2008). Additionally, NMFS discounted the functional capacity of modeled habitat units in areas where habitat degradation has affected the PCEs. For each SHRU, NMFS determined that 30,000 fully functional units of habitat are needed in order to achieve recovery objectives for Atlantic salmon. Brief historical descriptions for each SHRU, as well as contemporary critical habitat designations and special management considerations, are provided below.

Merrymeeting Bay SHRU

The Merrymeeting Bay SHRU drains approximately 2,691,814 hectares of land (6,651,620 acres) and contains approximately 372,600 units of historically accessible spawning and rearing habitat for Atlantic salmon located among approximately 5,950 km of historically accessible rivers, lakes and streams. Of the 372,600 units of spawning and rearing habitat, approximately 136,000 units of habitat are considered to be currently occupied. There are forty-five HUC 10 watersheds in this SHRU, but only nine are considered currently occupied. Of the 136,000 occupied units within the Merrymeeting Bay SHRU, NMFS calculated these units to be the equivalent of nearly 40,000 functional units or approximately 11 percent of the historical functional potential. This estimate is based on the configuration of dams within the Merrymeeting Bay SHRU that limit migration and other land use activities that cause degradation of physical and biological features and which reduce the productivity of habitat within each HUC 10. The combined qualities and quantities of habitat available to Atlantic salmon within the currently occupied areas within the Merrymeeting Bay SHRU meet the objective of 30,000 fully functional units of habitat available to Atlantic salmon. Lands controlled by the Department of Defense within the Little Androscoggin HUC 10 and the Sandy River HUC 10 are excluded as critical habitat.

In conclusion, the June 19, 2009 final critical habitat designation for the GOM DPS includes 45 specific areas occupied by Atlantic salmon that comprise approximately 19,571 km of perennial river, stream, and estuary habitat and 799 square km of lake habitat within the range of the GOM DPS and on which are found those physical and biological features essential to the conservation of the species. Within the occupied range of the GOM DPS, approximately 1,256 km of river, stream, and estuary habitat and 100 square km of lake habitat have been excluded from critical habitat pursuant to section 4(b)(2) of the ESA.

Summary of Factors Affecting Recovery of Atlantic Salmon

The recovery plan for the GOM DPS (NMFS and USFWS 2005) and the most recent status review (Fay *et al.* 2006) provide a comprehensive assessment of the many factors, including both threats and conservation actions, currently impacting listed Atlantic salmon.

Efforts to Protect the GOM DPS and its Critical Habitat

Efforts aimed at protecting Atlantic salmon and their habitats in Maine have been underway for well over one hundred years. These efforts are supported by a number of federal, state, and local government agencies, as well as many private conservation organizations. The 2005 recovery plan for the originally-listed GOM DPS (NMFS and USFWS 2005) presented a strategy for recovering Atlantic salmon that focused on reducing the severest threats to the species and immediately halting the decline of the species to prevent extinction. The 2005 recovery program included the following elements:

1. Protect and restore freshwater and estuarine habitats;
2. Minimize potential for take in freshwater, estuarine, and marine fisheries;
3. Reduce predation and competition for all life-stages of Atlantic salmon;
4. Reduce risks from commercial aquaculture operations;
5. Supplement wild populations with hatchery-reared DPS salmon;
6. Conserve the genetic integrity of the DPS;
7. Assess stock status of key life stages;
8. Promote salmon recovery through increased public and government awareness; and
9. Assess effectiveness of recovery actions and revise as appropriate.

A wide variety of activities have focused on protecting Atlantic salmon and restoring the GOM DPS, including (but not limited to) hatchery supplementation; removing dams or providing fish passage; improving road crossings that block passage or degrade stream habitat; protecting riparian corridors along rivers; reducing the impact of irrigation water withdrawals; limiting effects of recreational and commercial fishing; reducing the effects of finfish aquaculture; outreach and education activities; and research focused on better understanding the threats to Atlantic salmon and developing effective restoration strategies. In light of the 2009 GOM DPS listing and designation of critical habitat, the Services expect to produce a new recovery plan for Atlantic salmon.

Threats to Atlantic Salmon Recovery

A threats assessment done as part of the recovery plan resulted in the following list of high priority threats requiring action to reverse the decline of GOM DPS salmon populations:

- Acidified water and associated aluminum toxicity, which decrease juvenile survival
- Aquaculture practices, which pose ecological and genetic risks
- Avian predation
- Changing land use patterns (e.g., development, agriculture, forestry)
- Climate change
- Depleted diadromous fish communities
- Incidental capture of adults and parr by recreational anglers
- Introduced fish species that compete or prey on Atlantic salmon
- Low marine survival
- Poaching of adults in DPS rivers
- Recovery hatchery program (potential for artificial selection/domestication)
- Sedimentation of spawning and rearing habitat
- Water extraction

Fay *et al.* (2006) examined each of the five statutory ESA listing factors and determined that each of the five listing factors is at least partly responsible for the present low abundance of the GOM DPS. The information presented in Fay *et al.* (2006) is reflected in and supplemented by the final listing rule for the new GOM DPS (74 FR 29344; June 19, 2009). The following gives a brief overview of the five listing factors as related to the GOM DPS.

1. **Present or threatened destruction, modification, or curtailment of its habitat or range** – Historically and, to a lesser extent currently, dams have adversely impacted Atlantic salmon by obstructing fish passage and degrading riverine habitat. Dams are considered to be one of the primary causes of both historic declines and the contemporary low abundance of the GOM DPS. Land use practices, including forestry and agriculture, have reduced habitat complexity (e.g., removal of large woody debris from rivers) and habitat connectivity (e.g., poorly designed road crossings) for Atlantic salmon. Water withdrawals, elevated sediment levels, and acid rain also degrade Atlantic salmon habitat.

2. **Overutilization for commercial, recreational, scientific, or educational purposes** – While most directed commercial fisheries for Atlantic salmon have ceased, the impacts from past fisheries are still important in explaining the present low abundance of the GOM DPS. Both poaching and by-catch in recreational and commercial fisheries for other species remain of concern, given critically low numbers of salmon.

3. **Predation and disease** – Natural predator-prey relationships in aquatic ecosystems in the GOM DPS have been substantially altered by introduction of non-native fishes (e.g., chain pickerel, smallmouth bass, and northern pike), declines of other native diadromous fishes, and alteration of habitat by impounding free-flowing rivers and removing instream structure (such as removal of boulders and woody debris during the log-driving era). The threat of predation on the GOM DPS is noteworthy because of the imbalance between the very low numbers of returning adults and the recent increase in populations of some native predators (e.g., double-crested cormorant), as well as non-native predators. Atlantic salmon are susceptible to a number of diseases and parasites, but mortality is primarily documented at conservation hatcheries and aquaculture facilities;

4. **Inadequacy of existing regulatory mechanisms** – The ineffectiveness of current federal and state regulations at requiring fish passage and minimizing or mitigating the aquatic habitat impacts of dams is one of the significant threats to the GOM DPS today. Furthermore, most dams in the GOM DPS do not require state or federal permits. Although the State of Maine has made substantial progress in regulating water withdrawals for agricultural use, threats still remain within the GOM DPS, including those from the effects of irrigation wells on salmon streams;

5. **Other natural or manmade factors** – Poor marine survival rates of Atlantic salmon are a significant threat, although the causes of these decreases are unknown. The role of ecosystem function among the freshwater, estuarine, and marine components of the Atlantic salmon's life history, including the relationship of other diadromous fish species in Maine (e.g., American shad, alewife, sea lamprey), is receiving increased scrutiny in its contribution to the current status of the GOM DPS and its role in recovery of the Atlantic salmon. While current state and federal regulations pertaining to finfish aquaculture have reduced the risks to the GOM DPS (including eliminating the use of non-North American

Atlantic salmon and improving containment protocols), risks form the spread of diseases or parasites and from farmed salmon escapees interbreeding with wild salmon still exist.

Threats to Critical Habitat within the GOM DPS

The final rule designating critical habitat for the GOM DPS identifies a number of activities that have and will likely continue to impact the biological and physical features of spawning, rearing, and migration habitat for Atlantic salmon. These include agriculture, forestry, changing land-use and development, hatcheries and stocking, roads and road-crossings and other instream activities (such as alternative energy development), mining, dams, dredging, and aquaculture. Most of these activities have or still do occur, at least to some extent, in each of the three SHRUs.

The Penobscot SHRU once contained high quality Atlantic salmon habitat in quantities sufficient to support robust Atlantic salmon populations. The mainstem Penobscot has the highest biological value to the Penobscot SHRU because it provides a central migratory corridor crucial for the entire Penobscot SHRU. Dams, along with degraded substrate and cover, water quality, water temperature, and biological communities, have reduced the quality and quantity of habitat available to Atlantic salmon populations within the Penobscot SHRU. A combined total of twenty FERC-licensed hydropower dams in the Penobscot SHRU significantly impede the migration of Atlantic salmon and other diadromous fish to nearly 300,000 units of historically accessible spawning and rearing habitat. Agriculture and urban development largely affect the lower third of the Penobscot SHRU below the Piscataquis River sub-basin by reducing substrate and cover, reducing water quality, and elevating water temperatures. Introductions of smallmouth bass and other non-indigenous species significantly degrade habitat quality throughout the mainstem Penobscot and portions of the Mattawamkeag, Piscataquis, and lower Penobscot sub-basins by altering predator/prey relationships. Similar to smallmouth bass, recent Northern pike introductions threaten habitat in the lower Penobscot River below the Great Works Dam.

Today, dams are the greatest impediment, outside of marine survival, to the recovery of salmon in the Kennebec and Androscoggin river basins (Fay *et al.* 2006). Hydropower dams in the Merrymeeting Bay SHRU significantly impede the migration of Atlantic salmon and other diadromous fish and either reduce or eliminate access to roughly 352,000 units of historically accessible spawning and rearing habitat. In addition to hydropower dams, agriculture and urban development largely affect the lower third of the Merrymeeting Bay SHRU by reducing substrate and cover, reducing water quality, and elevating water temperatures. Additionally, smallmouth bass and brown trout introductions, along with other non-indigenous species, significantly degrade habitat quality throughout the Merrymeeting Bay SHRU by altering natural predator/prey relationships.

Status of Atlantic Salmon in the Action Area

Adult Atlantic salmon ascend the rivers of New England beginning in the spring and continuing into the fall, with the peak occurring in June. Spawning occurs in late October through November. In late March or April, the eggs hatch into larval alevins or sac fry. Alevins remain in the redd for about six weeks and are nourished by their yolk sac. Alevins emerge from the gravel about mid May, generally at night, and begin actively feeding. The survival rate of these fry is affected by stream gradient, overwintering temperatures and water flows, and the level of predation and competition (Bley and Moring 1988). Within days, the free-swimming fry enter the parr stage. In a parr's second or third spring, when it has grown to 12.5-15 cm in length, physiological, morphological and behavioral changes occur (Schaffer and Elson 1975). This process, called smoltification, prepares the parr for migration to the ocean and life in salt water. As smolts migrate from the rivers between April and June, they tend to travel near the water surface, where they must contend with changes in water temperature, pH, dissolved oxygen, pollution levels, and predation. Most smolts in New England rivers enter the sea during May and June to begin their ocean migration.

Counts for Atlantic salmon in the Kennebec River are available since 2006 (NMFS and USFWS 2009). In 2006, the Kennebec River trap count was 15 returning adult salmon; in 2007, the number was 16. In 2008, the number of Atlantic salmon observed at the Lockwood fish lift, which is located at the first dam on the river, was 22 fish with the majority (15) observed in July and the remainder in June (5), September (1), and October (1). To date in 2009, 24 adult Atlantic salmon have been documented at the Lockwood fish lift in 2009, with 14 in July and the remainder in May (1), June (4), August (1), September (1), and October (3) (ASC 2009).

As explained above, no dredging will be allowed between June 1 and September 30. In Maine, Atlantic salmon are only present within the mainstem of the Kennebec River between April 10 and November 7. As such, individual Atlantic salmon would only be exposed to effects of dredging if it occurred between April 10 – May 31 or October 1 and November 7. In the April 10 – May 31 time period, there could be a few early return adults migrating upstream through the action area as well as smolts migrating through the action area as they move downstream to the ocean. As all smolts are expected to have left the river by the end of June, during the October 1 – November 7 time period, the only life stage likely to be present is adults returning from the ocean and migrating to upstream spawning areas. Due to the location of the action area in the mainstem of the Kennebec River, no actively spawning adults, eggs or parr are likely to be present.

Shortnose Sturgeon

Shortnose sturgeon life history

Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 *in* NMFS 1998). Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers) when the freshwater temperatures increase to 8-9°C. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell et al. 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell et al. 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NMFS 1998). Thus, annual egg production is likely to vary greatly in this species. Fecundity estimates have been made and range from 27,000 to 208,000 eggs/female (Dadswell et al. 1984).

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20mm TL. Laboratory studies suggest that young sturgeon move downstream in a 2-step migration; a 2 to 3-day migration by larvae followed by a residency period by young of the year (YOY), then a resumption of migration by yearlings in the second summer of life (Kynard 1997). Juvenile shortnose sturgeon (3-10 years old) reside in the interface between saltwater and freshwater in most rivers (NMFS 1998).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NMFS 1998). In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures rise above 8°C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location and water temperature. Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998).

Shortnose sturgeon are believed to spawn at discrete sites within their natal river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during a four year telemetry study (Kieffer and Kynard 1996). Squires (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1996) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell et al. 1984; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8 - 12°, and bottom water velocities of 0.4 to 0.7 m/sec (Dadswell et al. 1984; NMFS 1998). For northern shortnose sturgeon, the temperature range for spawning is 6.5-18.0°C (Kieffer and Kynard in press). Eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell et al. 1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell et al. 1984; Hall et al. 1991). Non-spawning movements include wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney et al. 1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996). While shortnose sturgeon are occasionally collected near the mouths of rivers and often spend time in estuaries, they are not known to participate in coastal migrations and are rarely documented in their non-natal river.

The temperature preference for shortnose sturgeon is not known (Dadswell et al. 1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3°C (Dadswell et al. 1984) and as high as 34°C (Heidt and Gilbert 1978). However, temperatures above 28°C are thought to adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30°C during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges.

Shortnose sturgeon are known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon are known to occur at depths of up to 30m but are generally found in waters less than 20m (Dadswell et al. 1984; Dadswell 1979). Shortnose sturgeon have also demonstrated tolerance to a wide range of salinities. Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Mcleave et al. (1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age

(Kynard 1996). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989).

Status and Trends of Shortnose Sturgeon Rangewide

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication, issued by the US Department of the Interior, stated that shortnose sturgeon were "in peril...gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. In the late nineteenth and early twentieth centuries, shortnose sturgeon commonly were taken in a commercial fishery for the closely related and commercially valuable Atlantic sturgeon (*Acipenser oxyrinchus*). More than a century of extensive fishing for sturgeon contributed to the decline of shortnose sturgeon along the east coast. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery; possibly resulting in substantially reduced abundance of shortnose sturgeon populations within portions of the species' ranges (e.g., southernmost rivers of the species range: Santilla, St. Marys and St. Johns Rivers). A shortnose sturgeon recovery plan was published in December 1998 to promote the conservation and recovery of the species (see NMFS 1998). Shortnose sturgeon are listed as "vulnerable" on the IUCN Red List.

Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NMFS has not formally recognized distinct population segments (DPS)[4] of shortnose sturgeon under the ESA. Although genetic information within and among shortnose sturgeon occurring in different river systems is largely unknown, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997) and, therefore, should be considered discrete. The 1998 Recovery Plan indicates that while genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NMFS 1998).

Studies conducted since the issuance of the Recovery Plan have provided evidence that suggests that years of isolation between populations of shortnose sturgeon have led to morphological and genetic variation. Walsh et al. (2001) examined morphological and genetic variation of shortnose sturgeon in three rivers (Kennebec, Androscoggin, and Hudson). The study found that the Hudson River shortnose sturgeon population differed markedly from the other two rivers for most morphological features (total length, fork length, head and snout length, mouth width,

4 The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NMFS policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not been undertaken.

interorbital width and dorsal scute count, left lateral scute count, right ventral scute count). Significant differences were found between fish from Androscoggin and Kennebec rivers for interorbital width and lateral scute counts which suggests that even though the Androscoggin and Kennebec rivers drain into a common estuary, these rivers support largely discrete populations of shortnose sturgeon. The study also found significant genetic differences among all three populations indicating substantial reproductive isolation among them and that the observed morphological differences may be partly or wholly genetic.

Grunwald et al. (2002) examined mitochondrial DNA (mtDNA) from shortnose sturgeon in eleven river populations. The analysis demonstrated that all shortnose sturgeon populations examined showed moderate to high levels of genetic diversity as measured by haplotypic diversity indices. The limited sharing of haplotypes and the high number of private haplotypes are indicative of high homing fidelity and low gene flow. The researchers determined that glaciation in the Pleistocene Era was likely the most significant factor in shaping the phylogeographic pattern of mtDNA diversity and population structure of shortnose sturgeon. The Northern glaciated region extended south to the Hudson River while the southern non-glaciated region begins with the Delaware River. There is a high prevalence of haplotypes restricted to either of these two regions and relatively few are shared; this represents a historical subdivision that is tied to an important geological phenomenon that reflects historical isolation. Analyses of haplotype frequencies at the level of individual rivers showed significant differences among all systems in which reproduction is known to occur. This implies that although higher level genetic stock relationships exist (i.e., southern vs. northern and other regional subdivisions), shortnose sturgeon appear to be discrete stocks, and low gene flow exists between the majority of populations.

Waldman et al. (2002) also conducted mtDNA analysis on shortnose sturgeon from 11 river systems and identified 29 haplotypes. Of these haplotypes, 11 were unique to northern, glaciated systems and 13 were unique to the southern non-glaciated systems. Only 5 were shared between them. This analysis suggests that shortnose sturgeon show high structuring and discreteness and that low gene flow rates indicated strong homing fidelity.

Wirgin et al. (2005), also conducted mtDNA analysis on shortnose sturgeon from 12 rivers (St. John, Kennebec, Androscoggin, Upper Connecticut, Lower Connecticut, Hudson, Delaware, Chesapeake Bay, Cooper, Peedee, Savannah, Ogeechee and Altamaha). This analysis suggested that most population segments are independent and that genetic variation among groups was high.

The best available information demonstrates differences in life history and habitat preferences between northern and southern river systems and given the species' anadromous breeding habits, the rare occurrence of migration between river systems, and the documented genetic differences between river populations, it is unlikely that populations in adjacent river systems interbreed with any regularity. This likely accounts for the failure of shortnose sturgeon to repopulate river systems from which they have been extirpated, despite the geographic closeness of persisting populations. This characteristic of shortnose sturgeon also complicates recovery and persistence of this species in the future because, if a river population is extirpated in the future, it is unlikely that this river will be recolonized. Consequently, this Opinion will treat the nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) for the purposes of this analysis.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The range extended from the St John River in New Brunswick, Canada to the Indian River in Florida. Today, only 19 populations remain ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while northern populations are amphidromous (NMFS 1998). Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) and Merrimack Rivers (~100 adults; M. Kieffer, United States Geological Survey, personal communication), while the largest populations are found in the Saint John (~100,000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. Kynard 1996 indicates that all aspects of the species' life history indicate that shortnose sturgeon should be abundant in most rivers. As such, the expected abundance of adults in northern and north-central populations should be thousands to tens of thousands of adults. Expected abundance in southern rivers is uncertain, but large rivers should likely have thousands of adults. The only river systems likely supporting populations of these sizes are the St John, Hudson and possibly the Delaware and the Kennebec, making the continued success of shortnose sturgeon in these rivers critical to the species as a whole. While no reliable estimate of the size of either the total species or the shortnose sturgeon population in the Northeastern United States exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed.

Threats to shortnose sturgeon recovery

The Shortnose Sturgeon Recovery Plan (NMFS 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival.

Several natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon. Shortnose sturgeon continue to be taken incidentally in fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel et al. 1992; Collins et al. 1996). Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. Unless appropriate precautions are made, internal damage and/or death may result from blasting projects with powerful explosives. Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration and causing mortalities to fish that become entrained in turbines. Maintenance dredging of Federal navigation channels and other areas can adversely affect or jeopardize shortnose sturgeon populations. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. Mechanical dredges have also been documented to lethally take shortnose sturgeon. In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low dissolved oxygen event.

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sinderman 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Kennlyne 1993). Available data suggests that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Although there is scant information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectible levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry also determined that heavy metals and organochlorine compounds (i.e. PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increases proportionally with fish size (NMFS 1998).

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002).

Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs, DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. Contaminant analysis conducted in 2003 of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). While no directed studies of chemical contamination in shortnose sturgeon have been undertaken, it is evident that the heavy industrialization of the rivers where shortnose sturgeon are found is likely adversely affecting this species.

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28°C. Flourney et al.(1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress (i.e., in cool deep thermal refuges). In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flourney et al.1992; Rogers and Weber 1994; Weber 1996). The loss and/or manipulation of these discrete refuge habitats may limit or be limiting population survival, especially in southern river systems.

Pulp mill, silvicultural, agricultural, and sewer discharges, as well as a combination of non-point source discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. Shortnose sturgeon are known to be adversely affected by dissolved oxygen levels below 5 mg/L. Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28°C (Flourney et al. 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

Status of Shortnose Sturgeon in the Kennebec River

Shortnose sturgeon occur in the estuarine complex formed by the Sheepscot, Kennebec, and Androscoggin rivers. Sturgeon were tagged with Carlin tags from 1977 to 1980, with recoveries in each of the following years. A Schnabel estimate of 7,222 adults for the combined estuarine complex was computed from the tagging and recapture data from 1977 through 1981 (Squiers et al. 1982). The Maine Department of Marine Resources (DMR) conducted studies of shortnose sturgeon in the Kennebec River from 1996 through 2001. A Schnabel estimate using tagging and recapture data from 1998, 1999 and 2000 indicates a population estimate of 9488 for the estuarine complex.

On September 19, 1994, NMFS received a petition from the Edwards Manufacturing Company, Inc., to delist shortnose sturgeon occurring in the Androscoggin and Kennebec rivers. In the ensuing status review, NMFS found that the petition to delist this population segment was not warranted because: 1) the population estimate used by the petitioners was less reliable than the best estimate accepted by NMFS; 2) the best population estimate available did not exceed the interim threshold at which the population segment would be a candidate for delisting; 3) no recent information was available to assess the population dynamics; and 4) threats to shortnose sturgeon habitat still exist throughout the Androscoggin and Kennebec rivers (NMFS 1996).

Tracking studies to delineate spawning habitat were performed on the Androscoggin River during 1993. Gill nets were used to capture study animals and catch rates were recorded. Gill net catch-per-unit-effort during this study was the highest recorded in this area, suggesting that the population in the Androscoggin has increased since last surveyed. In 1999, the Edward's Dam, which represented the first significant impediment to the northward migration of shortnose sturgeon in the Kennebec River, was removed. With the removal of the dam, approximately 17 miles of previously inaccessible sturgeon habitat north of Augusta was made available. In May 2003, a shortnose sturgeon was observed at the base of the Lockwood Dam, confirming that shortnose sturgeon are now present in this area of the River. The Lockwood dam is located at the site of a natural falls (Ticonic Falls). It is not thought that historically shortnose sturgeon would have been able to pass upstream of these falls. Therefore, it is presumed that Ticonic Falls is the natural upstream limit for shortnose sturgeon in the Kennebec River.

No studies on shortnose sturgeon distribution throughout the Kennebec River have been initiated since the removal of the Edwards Dam making it difficult to assess the use of the area between the former Edwards Dam and the Lockwood Dam by shortnose sturgeon. However, since the removal of the Edwards Dam, NMFS has received many reports of occurrences of shortnose sturgeon located upstream of the location of the former Edwards Dam. The stranding of a shortnose sturgeon at the Lockwood Project in May 2003 confirms that shortnose sturgeon are migrating as far upstream as the Lockwood Project. It is unknown if additional spawning sites above the site of the former Edwards Dam are now being used. In populations of shortnose sturgeon that have free access to the total length of a river (e.g., no dam within the species' historical range in the river), spawning areas are located at the most upstream reach of the river used by sturgeon (NMFS 1998). Based on this pattern, it is likely that shortnose sturgeon may now be spawning at additional upriver sites.

The Schnabel estimate from 1998-2000 is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers as well and does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squiers et al. 1982) to 2000 (Maine DMR 2003) suggests that the adult population has grown by approximately 30% in the last twenty years. Based on this information, NMFS believes that the shortnose sturgeon population in the Kennebec River is increasing; however, without more information on the status of more recent year classes (i.e., juveniles) it is difficult to speculate about the long term survival and recovery of this population.

In the Kennebec River, movement to the spawning grounds occurs in early spring (April - May). Movement to the spawning areas is triggered in part by water temperature and fish typically arrive at the spawning locations when water temperatures are between 8-9°C. Spawning sites have been identified near Gardiner in the Kennebec River, at the base of the Brunswick Dam in the Androscoggin River, and may also occur in the Cathance River. In 1993, Maine DMR confirmed the exact location of the spawning sites in the Androscoggin River and determined that both adult and larval sturgeon use the region below the Brunswick Dam. Shortnose sturgeon quickly leave the spawning grounds for summer foraging areas when temperatures exceed 15°C (Squiers et al. 1982).

Summer foraging areas have been identified in the Sasanoa River entrance[5] and in the mainstem of the Kennebec River below Bath. Between June and September, shortnose sturgeon forage in shallow waters on mud flats that are covered with rooted aquatic plants. In the summer months, concentrations of shortnose sturgeon have also been known to move up into the freshwater reaches of the Kennebec River and foraging shortnose sturgeon have also been seen in Montsweag and Hockomock Bays in the Sheepscot River, which is located near the eastern end of the Sasanoa River (NMFS 1996).

Squiers (1982) reported that during 1979, concentrations of shortnose sturgeon were in the lower estuary below Bath during summer; in 1980 and 1981 large concentrations were found in the mid-estuary in the Bath region, most likely utilizing the abundant food resources in the Sasanoa River entrance. Subsequent tracking and trawl survey data from 1996-1999 indicate that shortnose sturgeon may be found in this area from at least late March through the beginning of December (Normandeau 1999). Studies indicate that at least a portion of the shortnose sturgeon population in the Kennebec River overwinters in Merrymeeting Bay (Maine DMR 1996). The seasonal migrations of shortnose sturgeon are believed to be correlated with changes in water temperature.

Until a study aimed at specifically determining overwintering locations was conducted by the Maine Department of Marine Resources (DMR) in 1996 for the Maine Department of Transportation (DOT), the sites thought to be the most likely overwintering sites were deep pools below Bluff Head, and possibly in adjacent estuaries such as the Sheepscot (Squiers and Robillard 1997). The 1996 study of overwintering activity suggests that at least one overwintering site is located above Bath. This is based on tracking 15 shortnose sturgeon collected and released in the vicinity of the Sasanoa River (Pleasant Cove), Winnegance Cove (near the Doubling Point reach), and Merrymeeting Bay (north of Bath and the Sasanoa River entrance). Tracking was done from October through January. Eleven of these fish were relocated in Merrymeeting Bay. Two of the fish from Pleasant Cove were never found in Merrymeeting Bay; one Pleasant Cove fish moved to Winnegance Cove and back to Pleasant Cove and another moved to Days Ferry (half way between Bath and Merrymeeting Bay). All of the fish that continued to transmit after November were only found in upper Merrymeeting Bay on the east-side of Swan Island. This is consistent with the trends for movement of shortnose sturgeon in the Delaware River (O'Herron 1992). Overwintering sturgeon in the Delaware River are found in the area of Newbold Island, in the Trenton to Kinkora river reach, in an area geographically similar to the area around Swan Island.

5 The Sasanoa River entrance is located directly across the Kennebec River from the Bath Iron Works facility. The river is less than ½ mile wide at this point.

Shortnose Sturgeon in the Action Area
Several studies were conducted in the late 1990s to document the presence and seasonal distribution of shortnose sturgeon near the BIW facility. The results of these studies as well as other available information on the presence of shortnose sturgeon in the action area is summarized below.

Fisheries sampling was conducted from April 1997 through June 1998 by Normandeau Associates, using a semi-balloon otter trawl with 1 ½ inch mesh in the cod end and a ¼ inch liner. Sampling occurred monthly in April, May and December. At the request of NMFS and Maine DMR, sampling frequency increased to twice monthly from June through November 1997 and April through June 1998. Trawl locations were located near the BIW outfitting pier (T1), south of the pier near the dry dock facility (T2), and south of Trufant Ledge (T3). In August, 1997 additional stations were added near Sasanoa Point (T4), Hanson Bay (T5), north of Hospital Point on the west (T6) and east (T7) shores, and in Winnegance Creek (T8). During high slack tide, two tows were made at each sampling location. Three of these sampling locations are in the vicinity of Doubling Point (T6, T7 and T8) (located approximately one nautical mile south of BIW). Results of the trawl study confirmed that shortnose sturgeon were present in the Bath area from April through November. No sampling was conducted between December and March.

In 1998, 17 shortnose sturgeon were collected via gillnet in the BIW area and were tagged and released near the capture site. Tracking began in 1998 and continued into 1999. Some of the fixed receivers were moved from their original locations and redeployed in areas of higher shortnose sturgeon abundance. In 1999, tracking was performed in three primary locations from late March through early May and mid-September through Mid-December. Through December 15, all scans detected shortnose sturgeon in the vicinity of BIW. No tracking was conducted between mid-December and mid-March.

In addition, trawling activities from 1999-2001 consistently captured shortnose sturgeon in the Bath area from April through November when trawls were deployed. Studies were not conducted outside of that time of year.

Based on tracking and trawl data detailed above, shortnose sturgeon are expected to be present in the BIW area year round. Concentrations of shortnose sturgeon are expected to be present in the action area from early April – mid November, with numbers being the highest in the summer months and at least a few individuals present throughout the winter. Shortnose sturgeon adults and juveniles are likely to be present in the action area during the dredging window of October 1 – May 31. Due to the distance from the spawning grounds (greater than 25 km), no spawning adults, eggs or larvae are likely to be present in the action area at any time of year.

ENVIRONMENTAL BASELINE
Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this biological opinion includes the effects of several activities that may affect the survival and recovery of the

endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, water quality, scientific research, and fisheries, and recovery activities associated with reducing those impacts.

Effects of Federal Actions that have Undergone Formal or Early Section 7 Consultation

Kennebec River Federal Navigation Channel

The authorized Federal navigation project in the Kennebec River consists of a channel 27 feet deep at mean low water (MLW) and 500 feet wide extending about 13 miles upstream from the river mouth at Popham Beach to the city of Bath. About eight miles upstream of Bath, the Federal navigation project provides for a navigation channel 17 feet deep MLW and 150 feet wide along the east side of Swan Island for 14 miles to the city of Gardiner. An 18-foot deep MLW and 150 feet wide channel extends through the ledge at Lovejoy Narrows opposite the upper end of Swan Island. A training wall was built along the Beef Rock Shoal opposite the lower end of Swan Island and another training wall was built opposite South Gardiner. A secondary channel 12 feet deep and 100 feet wide was provided along the west-side of Swan Island to Richmond, with the navigation channel deepening to 15 feet MLW near the upper end of Swan Island. A 16-foot deep MLW channel was provided at Gardiner. A channel 11 feet deep MLW and 150 feet wide extends seven miles to the upper limit of the Federal navigation project in Augusta.

The ACOE has been performing maintenance dredging at the Doubling Point and Popham Beach reaches in the Kennebec River Federal navigation channel since 1950 at approximately three-year intervals. These sites have been dredged a total of approximately 15 times since 1950. Dredging has been performed using a hopper dredge and the amount of material removed has ranged from 4,707 cy to 108,830 cy. Disposal sites have historically been located in the river north of Bluff Head in 95-100 feet of water and approximately 0.4 nautical miles south of Jackknife Ledge in depths of 40-50 feet. In recent years, dredging occurred in 1991, 1997, 2000, 2002 and most recently in October 2003 (see Table 1).

Table 1. Maintenance dredging of the Kennebec River Federal navigation Channel at Doubling Point since 1991.

Location	Dates	Volume Removed (cy)	Observer Present?	Interactions with Shortnose Sturgeon
Doubling Point	1991	10,000	No	2 lethal
Doubling Point	1997	10,000	Yes	0
Doubling Point	December 2000	10,000	Yes	0
Doubling Point	April 2002	10,000	Yes	0
Doubling Point	10/6-10/10/2003	10,000	Yes	3 lethal 2 injured but alive upon release

Several consultations have taken place between NMFS and ACOE on the effects of dredging the navigation channel on shortnose sturgeon. In 1989 and 1991, the ACOE implemented restrictions permitting dredging operations at the Doubling Point reach from September 15 to October 15 and from March 1 through April 30 and at Popham Beach from November 1 through April 30. Consultation on dredging in 1989 and 1991 was concluded informally, with NMFS concurring with the determination that dredging was not likely to adversely affect shortnose sturgeon.

During dredging operations in October 1991, two shortnose sturgeon with severe lacerations were observed floating just downstream of the dredge site. It was subsequently determined that these fish were killed during the ongoing maintenance dredging of the Doubling Point reach. On August 28, 1997, NMFS issued an Opinion to ACOE regarding the effects of maintenance dredging of the navigation channel. The dredging window that was established in 1997 allowed dredging in both the Doubling Point and Popham Beach areas from November 1 through April 30. No interactions with shortnose sturgeon were observed during dredging operations completed in November 1997.

In a letter dated November 29, 2000, NMFS indicated that new information on the distribution of shortnose sturgeon in the Kennebec River was available and that the Opinion issued in 1997 would be amended to include a Term and Condition restricting dredging to the December 1 – March 1 time frame. Dredging of the Doubling Point reach was completed in December 2000 with no interactions with shortnose sturgeon observed.

Consultation was reinitiated in 2002. The ACOE proposed that dredging at Doubling Point be allowed from November 1 – April 30. NMFS issued an Opinion on April 16, 2002 on the effects of annual maintenance dredging of the navigation channel in the November 1 – April 30 time frame. Accompanying this Opinion was an Incidental Take Statement which authorized the annual incidental taking of 2 shortnose sturgeon at Doubling Point during December 1 – March 1 and a total of 4 shortnose sturgeon in the November 1 – November 30 or March 2 – April 30 time frame. Dredging occurred in late April 2002 with no interactions with shortnose sturgeon observed.

Due to emergency conditions, the Doubling Point and Popham Beach reaches were dredged most recently in October 2003. Dredging occurred over the course of four days with approximately 10,000 cubic yards of material removed from the channel. During this dredge operation, five shortnose sturgeon were entrained by a hopper dredge in the Doubling Point reach. Two of the sturgeon died on board the dredge. The remaining three fish were alive; however, two of the fish suffered significant injuries and although released, likely died due to the severity of their injuries. The fifth fish was released with minor injuries. An Opinion regarding the effects of the emergency dredging operations was issued to the ACOE on January 13, 2004. The navigation channel has not been dredged since October 2003.

Maintenance Dredging of BIW Facilities
As explained in the Consultation History section, maintenance dredging has occurred at the BIW sinking basin three times since construction was completed in January 2000 (see Table 2).

Dredging most recently occurred between December 14 and 24, 2003 with approximately 44,000 cy of material removed. Prior to that, dredging had occurred in April 2003 when one shortnose sturgeon was killed and in 2001 with no interactions with shortnose sturgeon observed.

Maintenance dredging also routinely occurs along berthing piers 1, 2 and 3 as well as in the Landing Grid area. Dredging of the Landing Grid last occurred in January 2008 with no interactions with listed species occurring. Dredging along Pier 3 was last conducted in June 2009. Dredging ceased part way through the first day when one shortnose sturgeon was observed on top of the debris placed in the scow. The fish was released alive with no apparent injuries. Approximately 1,200 cubic yards of material was removed during this one day dredge event. Dredging had last occurred between November 7 and 22, 2005 with 3,760 cy of material removed. Dredging had previously occurred in this area in 1997; dredging between March 31 and May 2, 1997 removed 6,480 cy of material and dredging between September 10 and October 6, 1997 removed 4,384 cy of material. No interactions with shortnose sturgeon were observed during the 1997 or 2005 dredging events. Dredging at Pier 2 last occurred between June 6 – June 8 and June 19 – 22, 2001 with approximately 3,320 cy of material was removed with a bucket dredge. One 68cm Atlantic sturgeon was captured in the dredge bucket and released apparently unharmed.

Table 2. Dredging Activities at Bath Iron Works since 1997 (all with mechanical dredge)

Location	Dates	Volume Removed (cy)	Observer Present?	Interactions with Sturgeon
Pier 3	3/31-5/2/1997	6,480	Yes	0
Pier 3	9/10-10/6/1997	4,384	Yes	0
Sinking Basin (original construction)	11/7/98-1/5/2000	500,000	4/2-10/31 only	0
Pier 2	6/6-6/8 and 6/19-6/22/2001	3,320	Yes	1 Atlantic captured in dredge bucket and released unharmed
Sinking Basin	4/7-4/30/2003	7,870	Yes	1 shortnose killed
Sinking Basin	12/14-12/24/2003	44,000	Yes	0
Landing Grid	November 2004	4,000 cy	Yes	0
Pier 3	9/23-9/30/2005	1,900	Yes	0
Pier 3	11/7-11/22/2005	3,760	Yes	0
Sinking Basin	November – December 2007	70,000	Yes	0
Landing Grid	January 2008	1,200 cy	Yes	0
Pier 3	June 1, 2009	1,000 cy	Yes	1 shortnose sturgeon

				captured in dredge bucket and released unharmed

Lockwood Hydroelectric Project
The Federal Energy Regulatory Commission (FERC) issued a new license for the continued operation of the Lockwood Hydroelectric Project located in Waterville, Maine on March 4, 2005. Consultation between FERC and NMFS resulted in the issuance of an Opinion dated January 12, 2005 that analyzed the effects of the operation of the Lockwood project under the terms of the new License on shortnose sturgeon in the Kennebec River. The accompanying Incidental Take Statement exempted the take of two shortnose sturgeon annually due to stranding in pools below the dam during low flows associated with flashboard repair or replacement. No interactions with shortnose sturgeon have been recorded since the stranding of a shortnose sturgeon at the facility in the spring of 2004.

Effects of Non-Federally Regulated Actions
Non-Federally Regulated Fishery Operations
Unauthorized take of shortnose sturgeon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in other anadromous fisheries along the East Coast and may be targeted by poachers (NMFS 1998). The Kennebec River is an important corridor for migratory movements of various species including alewife (*Alosa pseudohernegus*), American eel (*Anguilla rostrata*), Atlantic sturgeon (*Acipenser oxyrhynchus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*) and lobster (*Homarus americanus*). Historically, the river and its tributaries supported the largest commercial fishery for shad in the State of Maine. However, pollution and the construction of dams decimated the shad runs in the late 1920's and early 1930's. Shortnose sturgeon in the Kennebec River may have been taken as bycatch in the shad fishery or other fisheries active in the action area. It has been estimated that approximately 20 shortnose sturgeon are killed each year in the commercial shad fishery and an additional number are also likely taken in recreational fisheries (T. Savoy pers. comm. in NMFS 1998). However, the incidental take of shortnose sturgeon in the river has not been well documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon. Due to a lack of reporting, no information on the number of shortnose sturgeon caught and released or killed in commercial or recreational fisheries on the Kennebec River is available.

Unauthorized take of Atlantic salmon is prohibited by the ESA. However, if present, Atlantic salmon juveniles may be taken incidentally in fisheries by recreational anglers. Due to a lack of reporting, no information on the number of Atlantic salmon caught and released or killed in recreational fisheries in the Kennebec River is available.

Other Potential Sources of Impacts in the Action Area
Scientific Studies
Research projects conducted in the Kennebec River since shortnose sturgeon were first detected in 1971 may have influenced shortnose sturgeon survival, reproduction and/or migration. Research projects conducted in the action area included, but were not limited to, capturing,

measuring, weighing, tagging (internal and external) and obtaining eggs from shortnose sturgeon. There are no current research projects in the Kennebec River permitted by NMFS.

Mr. Tom Squiers of Maine's Department of Marine Resources (DMR) possessed various ESA Section 10(a)(1)(A) Permits to conduct scientific research on shortnose sturgeon in Maine waters, including the Kennebec River, from 1976 through 2001. Over the life of these various permits, several thousand shortnose sturgeon were captured, handled and tagged. Several shortnose sturgeon died as a result of research activities, most often due to entanglement in gill nets. For example, from 1977-1996, 1780 shortnose sturgeon were captured and 30 died. From 1997-2001, approximately 1000 shortnose sturgeon were captured and there were 3 reported mortalities.

Ms. Gail Wipplehauser of Maine DMR currently possesses a Section 10(a)(1)(A) Permit to conduct scientific research on shortnose sturgeon in the Kennebec River. The permit is valid from November 2006 – November 2011. The permit authorizes (annually) capturing, handling, weighing and releasing 500 juvenile or adult shortnose sturgeon each year. Of these 500 fish, 480 may receive PIT tags and 20 may be acoustically tagged. The permit also authorizes the lethal capture of up to 30 shortnose sturgeon eggs and larvae. No research has been conducted under this permit to date.

On July 27, 2007 NMFS Office of Protected Resources issued a Biological Opinion on the effects of issuing a grant to Maine DMR to fund a conservation program for rainbow smelt, Atlantic sturgeon and Atlantic salmon. The activities will occur in several rivers in Maine including the Kennebec River. The Opinion exempts the incidental take of up to 10 live shortnose sturgeon (due to entanglement in gill net gear) and up to 50 shortnose sturgeon eggs in D-nets. No research has been conducted under this program to date.

MDMR has conducted periodic monitoring of Atlantic salmon populations in the Kennebec River. MDMR was authorized in 2009 to sample listed Atlantic salmon in the GOM DPS under the USFWS' endangered species blanket permit (No. 697823) issued pursuant to Section 10(a)(1)(A) of the ESA. Under USFWS permit No. 697823, MDMR is authorized to take (typically meaning capture) up to 2% of any given lifestage of Atlantic salmon during scientific research and recovery efforts (except for adults of which less than 1% can be taken). Lethal take of salmon in the Kennebec River during MDMR sampling is expected to be less than 2% consistent with take estimates for other Maine streams where such records are maintained by MDMR.

It is possible that research in the action area may have influenced and/or altered the migration patterns, reproductive success, foraging behavior, and survival of shortnose sturgeon. Shortnose sturgeon have also been incidentally captured in research activities targeting other species. Most recently, five shortnose sturgeon were captured in a beach seine targeting striped bass in the Kennebec River in the spring of 2007.

Contaminants and Water Quality
Contaminants including heavy metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), can have serious, deleterious effects on aquatic

life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). Contaminant analysis of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). Thomas and Khan (1997) demonstrated that exposure to cadmium at concentrations well below the concentration detected in the shortnose sturgeon significantly increased ovarian production of estradiol and testosterone which can adversely affect reproductive function. The concentration of zinc detected in the shortnose sturgeon liver tissue was slightly less than the effect concentration for reduced egg hatchability reported by Holcombe et al. (1979) and exceeded the effect concentration for reduced survival cited in Flos et al. (1979).

Ruelle and Henry (1994) determined that heavy metals and organochlorine compounds (i.e., PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. PCBs may also contribute to a decreased immunity to fin rot. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NMFS 1998).

Contaminant analysis conducted in 2003 of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003).

Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon and salmon populations. The compounds associated with discharges can alter the pH or receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

Hydroelectric facilities
The Lockwood Dam is the first impediment to upstream migration on the Kennebec River

mainstem. The Lockwood Project includes a fish lift which adult Atlantic salmon have been documented to use, with 15-24 adults documented annually between 2006 and 2009.

There are 9 facilities upstream of the Lockwood Project on the mainstem Kennebec River and an additional 4 on upstream tributaries. There are also 7 facilities located on downstream tributaries. While the effects of these other facilities are largely unknown, they all have the potential to affect flow and water quality in the River and may affect Atlantic salmon in the action area and may impede salmon movements within this river system. To the extent that these upstream facilities affect water conditions (flow, quantity, quality) downstream of the Lockwood project, the operation of these facilities may also affect shortnose sturgeon habitat and/or migration patterns.

Global Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities - frequently referred to in layman's terms as "global warming." Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The EPA's climate change webpage provides basic background information on these and other measured or anticipated effects (see www. epa.gov/climatechange/index.html). Activities in the action area that may have contributed to global warming include the combustion of fossil fuels by vessels.

The impact of climate change on Atlantic salmon is likely to be related to ocean acidification, changes in water temperatures, potential changes to salinity in rivers, and the potential decline of forage. These changes may effect the distribution of species and the fitness of individuals and populations due to the potential loss of foraging opportunities, displacement from ideal habitats and potential increase in susceptibility to disease (Elliot and Simmonds 2007). A decline in reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of Atlantic salmon in the action area, and throughout their range.

The impact of climate change on shortnose sturgeon in the action area is likely to be related to changes in water temperatures, potential changes to salinity in rivers, and the potential decline of forage. These changes may effect the distribution of species and the fitness of individuals and populations due to the potential loss of foraging opportunities, displacement from ideal habitats and potential increase in susceptibility to disease (Elliot and Simmonds 2007). Similarly to sea turtles, a decline in reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of shortnose sturgeon in the action area, and throughout their range.

As described above, global climate change is likely to negatively affect shortnose sturgeon and Atlantic salmon by affecting the distribution of prey, water temperature and water quality. To the extent that air pollution, for example from the combustion of fossil fuels by vessels operating in the action area, contributes to global climate change, then it is also expected to negatively affect shortnose sturgeon and Atlantic salmon in the action area.

Cumulative threats from other activities

Cumulative impacts from federal and private actions occurring in the Kennebec River have the potential to impact shortnose sturgeon and Atlantic salmon. These include direct and indirect modification of habitat due to hydroelectric facilities and the introduction of pollutants from paper mills, sewers, and other industrial sources. Hydroelectric facilities can alter the river's natural flow pattern and temperatures and release of silt and other fine river sediments during dam maintenance can be deposited in sensitive spawning habitat nearby. Pollution has been a major problem for this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Shortnose sturgeon in the Kennebec River can often be seen leaping out of the water. This activity has been linked to an increased likelihood of boat strikes and the potential for stranding. For example, in 1997 the Maine DMR documented a dead female shortnose sturgeon in the bottom of a boat at a marina in Bath and BIW has reported a dead shortnose sturgeon on a dock at their facility. Shortnose sturgeon in the Kennebec River are also subject to the threat of dredging, as evidenced by the mortality of at least five shortnose sturgeon in this river system since 2003, and subject to interactions with research targeting shortnose sturgeon and other species.

Cumulative impacts from federal and private actions occurring in the Kennebec River have the potential to impact Atlantic salmon and critical habitat designated for this species. These include direct and indirect modification of habitat due to hydroelectric facilities and the introduction of pollutants from paper mills, sewers, and other industrial sources. Hydroelectric facilities can alter the river's natural flow pattern and temperatures and release of silt and other fine river sediments during dam maintenance can be deposited in sensitive spawning habitat nearby. These facilities also often represent barriers to normal upstream and downstream movements. Passage through these facilities may result in the mortality of downstream migrants. Pollution has been a major problem for this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons).

Summary and synthesis of the Status of Species, Environmental Baseline, and Cumulative Effects sections

The Status of the Species, Environmental Baseline, and Cumulative Effects Sections, taken together, establish a "baseline" against which the effects of the proposed action are analyzed to determine whether the action—the ACOE's proposed authorization of 10 years of maintenance dredging at the BIW facility - is likely to jeopardize the continued existence of the species. To the extent available information allows, this "baseline" (which does not include the future effects of the proposed action) would be compared to the backdrop plus the effects of the proposed action. The difference in the two trajectories would be reviewed to determine whether the proposed action is likely to jeopardize the continued existence of the species. This section synthesizes the Status of the Species, the Environmental Baseline, and Cumulative Effects sections as best as possible given that some information on Atlantic salmon and shortnose sturgeon is quantified, yet much remains qualitative or unknown.

Summary of status of shortnose sturgeon
Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. Today, only 19 populations

remain. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. Population sizes range from under 100 adults in the Cape Fear and Merrimack Rivers to tens of thousands in the St. John and Hudson Rivers. As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. The only river systems likely supporting populations close to expected abundance are the St John, Hudson and possibly the Delaware and the Kennebec (Kynard 1996), making the continued success of shortnose sturgeon in these rivers critical to the species as a whole.

The Schnabel estimate based on Maine DMR survey data from 1998-2000 is the most recent population estimate for the Kennebec River shortnose sturgeon population; however, this estimate includes fish from the Androscoggin and Sheepscot rivers as well and does not include an estimate of the size of the juvenile population. A comparison of the population estimate for the estuarine complex from 1982 (Squiers et al. 1982) to 2000 (Maine DMR 2003) suggests that the adult population has grown by approximately 30% in the last twenty years. Based on this information, NMFS believes that the shortnose sturgeon population in the Kennebec River is increasing; however, without more information on the status of more recent year classes (i.e., juveniles) and a better understanding of how the spawning population is distributed between the Kennebec and Androscoggin Rivers it is difficult to speculate about the long term survival and recovery of this population.

While no reliable estimate of the size of either the shortnose sturgeon population in the Northeastern US or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. Based on the number of adults in population for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. The lack of information on the status of populations such as that in the Chesapeake Bay add uncertainty to any determination on the status of this species as a whole. Based on the best available information, NMFS believes that the status of shortnose sturgeon throughout their range is at best stable, with gains in populations such as the Hudson, Delaware and Kennebec offsetting the continued decline of southern river populations, and at worst declining.

Summary of status of Atlantic salmon

Adult returns for the GOM DPS remain well below conservation spawning escapement (CSE) goals that are widely used (ICES 2005) to describe the status of individual Atlantic salmon populations. When CSE goals are met, Atlantic salmon populations are generally self-sustaining. When CSE goals are not met (i.e., less than 100 percent), populations are not reaching full potential; and this can be indicative of a population decline. For all GOM DPS rivers in Maine, current Atlantic salmon populations (including hatchery contributions) are well below CSE levels required to sustain themselves (Fay *et al.* 2006), which is further indication of their poor population status.

The number of GOM DPS Atlantic salmon in the Kennebec River is very small, with adult returns from 2006-2008 ranging between 15 and 22; for 2009, 24 returns were documented through October 13, 2009.

The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 10%) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS. Based on the best available information, NMFS believes that the status of Atlantic salmon throughout their range is at best stable and at worst declining.

EFFECTS OF THE ACTION

This section of an Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). This Opinion examines the likely effects (direct and indirect) of the proposed action on shortnose sturgeon and Atlantic salmon in the action area and their habitat within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the proposed action under consideration in this Opinion is 10 years of maintenance dredging at the BIW facility (2009 – 2019) and the disposal of dredged material resulting from this dredging.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any change in the conservation value of the primary constituent elements of that critical habitat. This analysis focuses on statutory provisions of the ESA, including those in Section 3 of the Act that define "critical habitat" and "conservation," in Section 4 that describe the designation process, and in Section 7 that set forth the substantive protections and procedural aspects of consultation. Although some "properly functioning" habitat parameters are generally well known in the fisheries literature (e.g., thermal tolerances), for others, the effects of any adverse impacts are considered in more qualitative terms. This analysis does not rely on the regulatory definition of "adverse modification or destruction" of critical habitat recently at issue in the 9th Circuit Court of Appeals (Gifford Pinchot Task Force et al. v. U.S. Fish and Wildlife Service, No. 03-35279, August 6, 2004).

As explained in the Description of the Action section above, dredging with a crane mounted clamshell dredge will be used for maintenance dredging at all locations. Refer to Appendix A for locations of each area to be dredged. Below, the discussion will consider the effects of mechanical dredging, including the risk of capture of fish as well as the effects of suspended sediment associated with the dredging operations. Following, there is a discussion of the effects of disposal activities and a discussion of other effects of the proposed dredging including effects on prey and foraging. Last, there is a discussion on the effects of the proposed dredging and disposal operations on critical habitat designated for Atlantic salmon. As the effects of the action are related to the seasonal presence and abundance of shortnose sturgeon and Atlantic salmon in the action area, the discussion of effects presented below is preceded by a summary of the best available information on the seasonal distribution of these species in the action area.

Shortnose sturgeon in the Action Area

Based on trawling data, dredge observer reports, and tracking data, shortnose sturgeon are expected to occur in the Bath region year round, with the largest numbers being present from mid-spring to early fall. The highest concentration of shortnose sturgeon is expected in the Bath area between June and September when shortnose sturgeon are on the summer foraging grounds which include the entrance to the Sassanoa River, located less than half a mile across the river from the sinking basin and included in the action area for this consultation, and the mainstem Kennebec River immediately below Bath. During the June through September time period, large concentrations of adult fish are known to be actively foraging in this region and hundreds of shortnose sturgeon have been documented in the action area at this time.

The majority of shortnose sturgeon in the Kennebec River overwinter in the Merrymeeting Bay area, located several miles upstream from Bath. Once water temperatures rise to 8°C, spawning adults move from the overwintering area to one of the upstream spawning locations in the Androscoggin or Kennebec River. Water temperatures greater than 10°C are thought to trigger movements of non-spawning adults and juveniles to downstream foraging areas. Based on the available data, shortnose sturgeon are likely to begin moving downstream away from the overwintering area in April and May. A large number of Kennebec River shortnose sturgeon spend the summer months in the action area, including the Sassanoa River entrance. When water temperatures drop to 10°C in the fall, the majority of fish return to the upriver overwintering grounds. However, the available data (see below) indicate that some small number of shortnose sturgeon remain in the Bath area throughout the winter months. Due to the increased distance from Bath to the spawning grounds compared to the distance between the Merrymeeting Bay overwintering area and the spawning grounds, it has been speculated that fish overwintering near Bath are non-spawning adults or large juveniles.

As noted in the description of the action, dredging would be prohibited between June 1 and September 30 each year: however, it may occur at anytime outside of this time period. Tracking studies detailed in the Status of the Species section above have occurred from mid-March through late December, with shortnose sturgeon detected in the action area throughout this time period. The latest winter detection date for shortnose sturgeon was December 31. No studies have been conducted from January through mid-March due to icing conditions and safety concerns.

An analysis of tracking studies conducted from 1996-1999 suggests that the numbers of shortnose sturgeon in the action area begins to decrease in early to mid November as water temperatures drop below 10°C and most shortnose sturgeon migrate upstream to the overwintering area in Merrymeeting Bay. Tracking conducted in 1996 and 1997 indicated that most shortnose sturgeon had moved upstream from the Bath area to the overwintering area by mid-late November. These studies also indicate that shortnose sturgeon are very mobile while in the action area and that at least some individuals remain in the Bath area through mid-December (when tracking ceased).

Beginning in 1998, 17 shortnose sturgeon were collected via gillnet in the BIW area and were tagged and released near the capture site. Tracking began in 1998 and continued into 1999. Some of the fixed receivers were moved from their original locations and redeployed in areas of higher shortnose sturgeon abundance. In 1999, tracking was performed in three primary locations from late March through early May and mid-October through Mid-December. Through December 15, all scans detected shortnose sturgeon in the vicinity of BIW. From October 21 through November 4, 1999, seven shortnose sturgeon were detected ranging from North to South of the BIW Pier, Chops Point, Fishers Eddy, and Doubling Point. Five of these sturgeon were in the immediate vicinity of BIW. From November 4 through November 12, 1999, four tagged shortnose sturgeon were detected, three of which were in the immediate vicinity of BIW. Tagged shortnose sturgeon were also tracked in the vicinity of BIW from November 18 – 23, one of which was in the immediate vicinity of BIW. The tracks from November 23 – December 15 detected two shortnose sturgeon in the immediate vicinity of BIW. No tracking was attempted after December 15 due to icing conditions in the Kennebec River.

Based on the best available data (discussed in the Status of the Species section above), shortnose sturgeon are expected to be in the immediate vicinity of the BIW facilities, including the areas to be dredged, during the time period in which dredging is proposed to occur (October 1 – May 31), with few individuals present between mid-November and late April. As shortnose sturgeon have been documented in the action area during the time of year proposed for dredging, interactions between shortnose sturgeon and the dredge operations are likely to occur. Shortnose sturgeon may be directly affected by being entrained in dredge equipment or by exposure to the sediment plume released during dredging operations.

Atlantic salmon in the Action Area

As explained in the Status of the Species section above, Atlantic salmon only occur in the mainstem of the Kennebec River between April 10 and November 7 each year. Upstream migrating adults could be present in the action area throughout this time period. Outmigrating smolts would be moving downstream through the action area from April through June. Due to the time of year when dredging will occur and the types of habitats in the action area, no spawning or overwintering fish will be affected; similarly no Atlantic salmon eggs or other early life stages would be present in the action area during this time of year. Additionally, as the action area consists of deep waters, no parr would occur in the action area.

Table 3.

Number of Atlantic salmon captured at the Lockwood Project fish trap in 2008 and 2009

	May	June	July	August	September	October
2008	0	5	15	0	1	1
2009	1	4	14	1	1	3

Dredging activities occurring between April 10 - May 31 and October 1 – November 7 will overlap with the time of year when Atlantic salmon could be present in the action area. No Atlantic salmon are likely to be present in the action area between November 8 and April 9; as such, any dredging occurring in this time period would not expose any Atlantic salmon to effects of the action. As noted above, in the spring dredge window (April 10-May 31) outmigrating smolts and returning adults could be present in the action area. In the fall dredge window, the only life stage likely to be present would be returning adults.

Returning adults are not known to forage while making their upstream migrations. Movements through the action area by migrating adults are likely to be rapid, with residence times of less than 1 day. Similarly, outmigrating smolts would be moving rapidly through the action area, and would also have residence times of less than 1 day. While smolts may forage opportunistically while migrating out of rivers, extensive foraging by smolts is not likely to occur in the action area.

Capture in Dredge Bucket

As noted above, a mechanical bucket dredge will be used for the proposed dredging. Aquatic species can be captured in dredge buckets and may be injured or killed from entrapment in the bucket or burial in sediment during dredging and/or when sediment is deposited into the dredge scow. Fish captured and emptied out ofthe bucket could suffer severe stress or injury, which could also lead to mortality.

Atlantic salmon

As explained above, Atlantic salmon are likely to be present in the action area during any dredging activity occurring between April 10 – May 31 and October 1 and November 7. There are no known incidences of Atlantic salmon being captured in a dredge bucket. As Atlantic salmon are highly mobile and not likely to be concentrated in the action area there is little risk of individuals being captured in the relatively slow moving dredge bucket. As such, the likelihood that an Atlantic salmon would be captured during any of the dredge events occurring over the 10 year life of the permit are discountable and no Atlantic salmon are likely to be injured or killed as a result of interactions with the dredge equipment.

Shortnose Sturgeon

Shortnose sturgeon may be injured or killed from entrapment in the bucket or burial in sediment during dredging and/or when sediment is deposited into the dredge scow. Sturgeon captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality. Few captures of sturgeon with dredge buckets have been reported. On April 30, 2003, a shortnose sturgeon was captured in a clam-shell bucket dredge operating in the BIW sinking basin in the Kennebec River. Documentation of the incident reveals that the fish was nearly cut in half. This fish was killed during the last hour of a 24-hour a day dredging operation that had been ongoing for approximately 6 weeks. In addition, an Atlantic sturgeon was killed in the Cape Fear River in a bucket and barge operation (NMFS 1998) and an Atlantic sturgeon was captured in a clamshell bucket, deposited in the dredge scow, and released apparently unharmed during dredging operations at BIW in 2001 (Maine DMR 2002). One shortnose sturgeon was captured in a clamshell bucket and detected in the dredge scow on June 1, 2009 during dredging operations at BIW. It is important to note that while nearly all of the recorded interactions between mechanical dredges and sturgeon have been during dredging at the BIW facility, it is unknown if this is due to a unique situation in this river or the intense observer coverage at dredging operations in this river. Very few other mechanical dredge operations have employed observers to document interactions between sturgeon and the dredge; therefore, it is possible that interactions during other projects have occurred but just not been observed.

Based on the occurrence of shortnose sturgeon in the area where mechanical dredging will take place and the documented vulnerability of this species to capture with mechanical dredges, it is likely that a small number of shortnose sturgeon will be captured by the mechanical dredge operating to remove sediment at the BIW facilities. Since 1997 when endangered species observers began staffing dredging projects at BIW, two shortnose sturgeon have been documented to be captured with a mechanical dredge. Only one of these events (April 30, 2003) occurred during the proposed October 1 – May 31 dredge window, with the other occurring on June 1, 2009. Based on the best available information, the risk that a shortnose sturgeon would be captured in the slow moving dredge bucket is relatively low. This is evidenced by the small number of shortnose sturgeon captured during dredging operations at BIW since 1997, despite the occurrence of over 10 dredge events, with dredging happening nearly every year.

The greatest risk for interactions between mechanical dredges and individual shortnose sturgeon at the BIW facility is likely in the summer months when large concentrations of shortnose sturgeon are present in the action area while moving between foraging areas. It has also been speculated that during the summer months sturgeon may seek out the deep holes at the sinking basin as a thermal refugia and also that they may use the Pier 3 area as a resting area as there is a unique low velocity area located at this site. As no dredging will occur between June 1 and September 30 the time of year with the greatest likelihood of sturgeon captured will be avoided.

As noted above, shortnose sturgeon begin moving to the overwintering area in October and begin to return to the action area in April, with only a few individuals present in the Bath area between mid-November and late April. It is likely that of the months when dredging will be allowed to occur, the highest risk for capture would be in May and October as more sturgeon would be present in the action area than during the other months when dredging could occur. As explained above, in 2009 dredging will occur in November and December. However, while BIW has stated that every effort will be made to complete all future dredging between November 8 and April 9, it is possible that dredging will occur in May or October.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years. For example, dredging in the BIW sinking basin prior to 2003 resulted in no interactions with shortnose sturgeon but one shortnose sturgeon was killed by the clamshell dredge in the last hour of the last day of dredging of a dredge event running from April 7 to April 30, 2003. Regardless, based on all available evidence, the risk of capture in a mechanical dredge is low. The likelihood of a dropping dredge bucket interacting with an individual shortnose sturgeon is low due to the slow speed at which the bucket moves and the relatively small area of the bottom it interacts with at any one time. However, the likelihood of an interaction is increased based on the number of the shortnose sturgeon likely to be in the area to be dredged and the length of time of dredging.

Despite the greater number of shortnose sturgeon likely to be present in the action area in May or October compared to November – April, the risk that an individual shortnose sturgeon would be captured in the dredge bucket is still low. As noted above, only two shortnose sturgeon have been captured during dredging events over the last 12 years. However, as dredging may occur outside of the time of year when the risk is lowest, NMFS expects that no more than 1 shortnose sturgeon is likely to be captured during each dredging event when a mechanical dredge is used.

As such, based on the proposed dredging schedule, it is likely that 1 shortnose sturgeon is likely to be captured in the fall 2009 dredging operations. One shortnose sturgeon is also likely to be captured during each of the subsequent maintenance dredging events which are currently predicted to be: 2012 (sinking basin only); 2013 (landing grid and berthing piers); 2015 (sinking basin); 2017 (landing grid and berthing piers); and, 2018 (sinking basin). Thus, a total of no more than 6 shortnose sturgeon are likely to be captured by a mechanical dredge operating to conduct maintenance dredging over the 10 year life of the permit.

Shortnose sturgeon captured in a dredge bucket could be injured or killed. Sources of mortality include injuries suffered during contact with the dredge bucket or burial in the dredge scow. Of the three captures of sturgeon with mechanical dredges in the Kennebec River (two shortnose, 1 Atlantic), one of the shortnose sturgeon was killed. This fish suffered from a large laceration, likely experienced due to contact with the dredge bucket. As the risk of mortality once captured is high, it is reasonable to expect that any of the shortnose sturgeon likely to be captured in the dredge bucket could suffer injury or mortality due to contact with the dredge bucket or through suffocation due to burial in the scow. Thus, it is likely that all 6 shortnose sturgeon captured in the dredge bucket are likely to be killed during maintenance dredging over the 10 year life of the permit.

Interactions with the Sediment Plume

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the river, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. Dredging with a mechanical dredge of the size to be used for the proposed dredging is a slow process. Depending on the extent of dredging planned in any given year, up to 60 days of dredging could be scheduled, with dredging occurring 8-24 hours a day depending on location and time of year of the proposed dredging.

Water quality studies conducted in the action area by Normandeau Associates in 1997 and 2001 indicate that this is a naturally turbid area with naturally occurring fluctuations in turbidity. In 2001, Normandeau Associates monitored water quality during dredging operations at Bath Iron Works. Pre-dredge total suspended solids (TSS) levels ranged from 20-49mg/L. The maximum observed TSS levels during and after dredging was 55mg/L. This level was recorded during an ebb tide, 50 feet from the dredge. Additional monitoring was conducted during dredging at the Pier 2 berthing area in 2002. Pre-dredge turbidity ranged from 5.0-7.9 NTU with TSS values ranging from 12 -18 mg/L. During dredging, TSS ranged from 24 to 43 mg/L. While increased turbidity was experienced at a distance of 150 feet from the dredge, the highest concentrations were limited to the area within 50 feet ofthe dredge. As explained above, the ACOE is requiring that BIW monitor TSS levels during dredging operations and will require that dredging operations cease if TSS levels are greater than 50mg/L above background concentrations. This will ensure that no shortnose sturgeon or Atlantic salmon will be exposed to TSS levels greater than 50mg/L above background concentration levels.

Monitoring of twelve mechanical dredge operations in the Delaware River (Burton 1993) in 1992 indicated that sediment plumes have fully dissipated by 3300-feet from the dredge area. The Delaware River study also indicated that mechanical dredging does not alter turbidity or dissolved oxygen to a biologically significant degree and analysis did not reveal a consistent trend of higher turbidity and lower dissolved oxygen within the sediment plume.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of TSS on shortnose sturgeon, shortnose sturgeon juveniles and adults are often documented in turbid water and Dadswell (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. As such, shortnose sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of shortnose sturgeon most vulnerable to increased sediment are eggs and larvae which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area. Juvenile and adult shortnose sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause shortnose sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column. Based on this information, any increase in suspended sediment is not likely to affect the movement of shortnose sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect shortnose sturgeon in the action area.

Suspended sediments can have lethal and sublethal effects on Atlantic salmon. Sublethal effects of suspended sediments can include impairment of swimming activity, respiration, and predator avoidance. Sedimentation has been identified as a threat particularly to early life stages of Atlantic salmon. Atlantic salmon smolts are particularly susceptible to stress-induced mortality during the transition to the marine environment. Atlantic salmon adults rely on olfactory sense to identify and navigate their natal river. In a review of the effects of sediment loads and turbidity on fish, Newcomb and Jensen (1996) concluded that more than 6 days exposure to total suspended solids (TSS) greater than 10 mg/l is a moderate stress for juvenile and adult salmonids and that a single day exposure to TSS in excess of 50 mg/l is a moderate stress. Atlantic salmon smolt movement through estuaries is rapid (LeBar *et at.* 1978, Tytler *et at.* 1978). Based upon this information, the duration of any exposure to sediment plumes during this proposed project, if at all, would likely be less than 1 day for migrating Atlantic salmon smolts. Although adult Atlantic salmon movement through estuaries is less understood, but it can also be expected that adults would not be exposed to a sediment plume for more than one day. As indicated above, a single day exposure to TSS in excess of 50 mg/l is a moderate stress to salmonids; however, as dredging must cease if TSS levels are greater than 50mg/L, no Atlantic salmon of any life stage are expected to be exposed to TSS levels of 50mg/L. As such, any effects of the sediment plume on Atlantic salmon will be insignificant. Additionally, as the sediment plume is expected to have largely dissipated within 150 feet of the dredge and the river is approximately 0.5 miles wide at the site of dredging, there will be a sufficient zone of passage where Atlantic salmon can migrate up or down stream without being exposed to any effects of the sediment plume.

Disposal Operations

Material removed from the berthing areas and the landing grid will be transported in scows to a nearby dock where it will be offloaded by crane into dump trucks and disposed of at a State-approved non wetland location. The only material that could be disposed of at an in river disposal site is material removed from the sinking basin which would be disposed of at the disposal site near Bluff Head.

Burial during disposal operations is another potential effect of dredging operations. Burial is probably most likely during the overwintering period when fish would be more lethargic and situated in deeper areas (such as disposal sites). Overwintering areas characteristically are areas of lower energy conditions, like deep pools, where the fish can expend less energy during a time period when they are not actively foraging. However, the above discussion on the location of shortnose sturgeon during the overwintering period suggests that concentrations of sturgeon would not be found at the dredge disposal site north of Bluff Head during the November through February time period. Furthermore, fish tracked during the fall and winter of 1997 and spring and fall of 1999 in the Doubling Point area, which is north of the disposal site, were making significant movements. While it is possible that some number of shortnose sturgeon may be present at or near the disposal site during the winter months, it is extremely unlikely that a juvenile or adult shortnose sturgeon would be buried due to the volume of material released from the scow at any one time, the type of sediment (i.e., coarse sand as opposed to heavy rocks) the dispersion of sediment throughout the water column as it falls, and the time it takes for material to reach the bottom. Burial during the spring and fall is also extremely unlikely to occur as shortnose sturgeon are very active at these times of year and are likely to be able to swim away from any sediment plume.

Shortnose sturgeon and Atlantic salmon near the disposal area may be exposed to increased suspended sediment levels. Impacts associated with this action include a short term localized increase in turbidity during disposal operations. During the discharge of sediment at a disposal site, suspended sediment levels have been reported as high as 500mg/L within 250 feet of the disposal vessel and decreasing to background levels within 1000-6500 feet (ACOE 1983). The ACOE has reported that disposal at Bluff Head can result in a plume of suspended sediment extending for up to 3000 feet from the disposal barge which is consistent with other available reports.

As explained above, exposure to elevated suspended sediment levels can cause stress to Atlantic salmon. The best available information indicates that an exposure of 50mg/L above background for more than 24 hours can be moderately stressful for Atlantic salmon. While disposal operations could result in TSS levels greater than 50mg/L above background, all efforts will be made to avoid in river disposal during the time of year when Atlantic salmon are likely to be present (i.e., April 10 – November 7). For the fall 2009 dredging, in river disposal will occur. However, as disposal will occur outside of the April 10 – November 7 window, no Atlantic salmon will be exposed to effects of disposal activities. As noted above, the ACOE is implementing a permit condition requiring that any future in river disposal occurring between April 10 – November 7 occur with a sediment management plan in place. This plan will require that should disposal operations occur during the time of year when salmon could be present, continuous monitoring of TSS will be required and mitigation measures will be put in place to ensure that TSS levels of 50 mg/L above background are not reached. The plan will also require that disposal operations cease should TSS levels of 50mg/L above background be reached. These requirements will ensure that no Atlantic salmon are exposed to TSS levels of 50mg/L or greater above background. As such, any effects of in river disposal on Atlantic salmon will be insignificant.

The best available information on the effects of TSS on shortnose sturgeon is summarized above. Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of TSS on shortnose sturgeon, shortnose sturgeon juveniles and adults are often documented in turbid water and Dadswell (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. As such, shortnose sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of shortnose sturgeon most vulnerable to increased sediment are eggs and larvae which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area. Juvenile and adult shortnose sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause shortnose sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column. Based on this information, any increase in suspended sediment is not likely to affect the movement of shortnose sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect shortnose sturgeon in the action area.

Release of Contaminated Sediment

In addition to the release of sedimentation, dredging operations also have the potential to release contaminants that are present in the material to be dredged. However, the coarse nature of the material to be dredged makes it unlikely that any contaminants would adhere to the sand particles. Additionally, the material in the sinking basin has been tested in the past and there is no evidence that the material to be dredged is contaminated. Therefore, no release of contaminated material is expected.

Effects to Shortnose Sturgeon Habitat

Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. Shortnose sturgeon foraging grounds in the Kennebec estuary are typically shallow waters and mud flats covered with rooted aquatic plants. The areas to be dredged are not consistent with the type of habitat that supports shortnose sturgeon forage items (Normandeau 1998). For example, benthic surveys noted a lack of the usual shortnose sturgeon forage items in the area even before it was dredged to its design depth in 1999. As the areas to be dredged are subject to constant scouring and resettling of sediment, it is unlikely that even the minor amount of benthic forage that was historically present has been re-established. As such, shortnose sturgeon are not likely to be feeding in the area to be dredged and any effects of the removal of any potential forage items during dredging operations will be insignificant.

Disposal operations can also affect foraging habitat by burying prey. However, the Bluff Head area is not known to be used by foraging shortnose sturgeon and any effects to shortnose sturgeon foraging will be insignificant.

Shortnose sturgeon are known to seek out deeper waters during the summer months that serve as thermal refugia. The sinking basin is consistent with the depths sought by shortnose sturgeon and water quality monitoring indicates that dissolved oxygen levels would be suitable for shortnose sturgeon (Normandeau 1997). It has also been speculated that the area surrounding the BIW facility is used by shortnose sturgeon as a resting area because of the low velocity zone that exists immediately downstream of the outfitting pier which provides a place for traveling fish to rest away from the main river current (Normandeau 1997). The proposed dredging will not alter the area in a manner that precludes shortnose sturgeon from using the action area for thermal refugia or as a resting area.

Critical Habitat designated for Atlantic salmon

The action area is a known migratory corridor for both juvenile and adult Atlantic salmon. A migratory corridor free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds or prevent emigration of smolts to the marine environment is identified in the critical habitat designation as essential for the conservation of Atlantic salmon. The Primary Constituent Elements (PCE) for designated critical habitat of listed Atlantic salmon in the action area are:

1) Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations;

2) Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation; and,

3) Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.

NMFS has analyzed the potential impacts of the project on designated critical and PCEs in the action area. NMFS has determined that the effects to these PCEs will be insignificant for the reasons outlined below.

The project will not result in a migration barrier as the turbidity and suspended solids present in the water column during dredging will only affect a small portion of the river at any given time. Based on historic monitoring data, TSS levels as high as 55 mg/L could be experienced; however these levels would only be present within 50 feet (15 meters) of the dredge. The ACOE will require monitoring to ensure that at a distance of 50 meters (164 feet) from the dredge, TSS levels remain below 50mg/L. The width of the river in the action area is approximately ½ mile. As such, the area where increased TSS would be experienced would be an extremely small area of the river at any given time. Similarly, should in river disposal occur at the time of year when Atlantic salmon are present, TSS levels during in river disposal operations will be monitored and restricted to 50mg/L above background. This will ensure that there is always a sufficient zone of passage past the dredging and disposal operations for any adult Atlantic salmon moving upstream or smolt migrating downstream through the action area. The proposed action will not alter the habitat in any way that would increase the risk of predation. Any effects to the water column will be limited to temporary increases in suspended sediment; there will be no other water quality impacts of the proposed action and therefore the project is not expected to adversely affect water quality at the time of any salmon migrations in the action area. Atlantic salmon present in the action area are not likely to be foraging. While dredging and disposal operations can affect benthic resources, salmon are not benthic feeders and the forage base for this species is not expected to be affected by dredging operations. Finally, as the action will not affect the natural structure of the nearshore habitat, there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of listed Atlantic salmon. Based upon this reasoning, NMFS has determined that any effects to designated critical habitat in the action area will be insignificant.

CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.

Several features of the shortnose sturgeon's natural history, including delayed maturation, non-annual spawning (Dadswell et al. 1984; Boreman 1997), and long life-span, affect the rate at which recovery can proceed. The effects of future state and private activities in the action area that are reasonably certain to occur during the dredging operations are recreational and commercial fisheries, pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

Impacts to shortnose sturgeon from non-federal activities are largely unknown in this river. It is possible that occasional recreational and commercial fishing for anadromous fish species may result in incidental takes of shortnose sturgeon. However, positive identification and distinction between Atlantic sturgeon and shortnose sturgeon are difficult and therefore, historically, takes have not been quantified. Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

Impacts to Atlantic salmon from non-federal activities are largely unknown in this river. It is possible that occasional recreational fishing for other fish species may result in incidental takes. There have been no documented takes in the action area, however, there is always the potential for this to occur when fisheries are known to operate in the presence of Atlantic salmon. The effects of future state and private activities in the action area that are reasonably certain to occur during the proposed action are recreational and commercial fisheries, discharge of pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

As noted above, impacts to listed species from all of these activities are largely unknown. However, NMFS has no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

INTEGRATION AND SYNTHESIS OF EFFECTS

The GOM DPS of Atlantic salmon is listed as endangered throughout its range. Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are still confronted with a variety of threats. Numbers of endangered adult Atlantic salmon returning to the GOM DPS are extremely low, with only 1014 adults in 2007, and only 16 of these returning to the Kennebec (NMFS and USFWS 2009). While there was a greater number of adults returning to the Kennebec in 2009 (24), the number is still extremely low. Based upon the best available scientific information, NMFS has determined that all effects of the proposed action on Atlantic salmon will be insignificant or discountable.

Critical Habitat designated for Atlantic salmon
As explained above, the proposed action will have only an insignificant effect on critical habitat designed for the GOM DPS of Atlantic salmon. This conclusion is based on the determination that there will be no permanent impacts to the habitat and because: (1) the project will not result in a migration barrier to or through any estuarine habitat; (2) the project will not increase the risk of predation; (3) the project is not expected to affect water quality at the time of any salmon migrations in the action area; (4) the project will not significantly affect the forage of juvenile or adult Atlantic salmon because of the timing and location; and, (5) there will be no effects to the natural structure of the nearshore habitat and therefore there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of listed Atlantic salmon.

Shortnose Sturgeon
Shortnose sturgeon are endangered throughout their entire range. This species exists as nineteen separate populations that show no evidence of interbreeding. The shortnose sturgeon residing in the Kennebec River form one of these nineteen populations.

NMFS has estimated that the proposed action, the authorization by the ACOE to BIW for ten years of maintenance dredging, will result in the mortality of up to 6 shortnose sturgeon due to capture in the dredge bucket and associated injury or due to deposition in the scow and subsequent injury or burial. As explained in the "Effects of the Action" section, all other effects on shortnose sturgeon and their habitat are likely to be insignificant or discountable.

As explained in the "Effects of the Action" section above, maintenance dredging at the BIW facility is likely to result in the capture of no more than 1 shortnose sturgeon each year that dredging occurs. As detailed in the Effects of the Action section above, dredging is expected to occur six times over the 10 year life of the permit. As such, NMFS has estimated that no more than 6 shortnose sturgeon are likely to be captured in the mechanical dredge removing sediment from the areas identified for dredging at the BIW facility. NMFS has determined that it is likely that all 6 of these sturgeon could suffer from injuries and die as a result of capture in the dredge bucket. Thus, in its entirety, the proposed action is likely to result in direct physical effects (i.e., capture, physical injury or mortality) to no more than 6 shortnose sturgeon, with no more than 6 mortalities.

While the dredging is likely to kill up to 6 shortnose sturgeon over a ten year period (i.e., 5 year initial deepening, plus 10 years of maintenance), this number represents a very small percentage of the shortnose sturgeon population in the Kennebec River, which is believed to be increasing, and an even smaller percentage of the total population of shortnose sturgeon rangewide. It is also important to note that this mortality estimate is considered to be a worst case scenario and is based on conservative assumptions outlined in the "Effects of the Action" section above. Additionally, no more than 1 mortality is expected to occur in any given year. The best available population estimates indicate that there are approximately 9500 adult shortnose sturgeon in the Kennebec River and an unknown number of juveniles. While the death of 6 juvenile or adult shortnose sturgeon will reduce the number of shortnose sturgeon in the population compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this population or its increasing trend as this loss represents only 0.0006% of the population.

This action is expected to have an undetectable reduction in reproduction of shortnose sturgeon in the Kennebec River because, at worst, it would result in the loss of no more than 1 pre-spawning shortnose sturgeon per year. As thousands of shortnose sturgeon are expected to spawn each year in the Kennebec River, the reduction in available spawners by no more than 1 each year and no more than 6 over the 10 year project period is expected to result in an insignificant reduction in the number of eggs laid or larvae produced and similarly, an insignificant effect on the strength of subsequent year classes. Additionally, the proposed action will not affect spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the Kennebec River. Further, the action is not expected to reduce the river by river distribution of shortnose sturgeon. Additionally as the number of shortnose sturgeon likely to be killed as a result of the proposed action is approximately 0.0006% of the Kennebec River population, there is not likely to be a loss of any unique genetic haplotypes and therefore, it is unlikely to result in the loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable effect on the numbers, reproduction and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of shortnose sturgeon because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity (see status of the species section above), and there are thousands of shortnose sturgeon spawning each year.

Based on the information provided above, the death of up to 6 shortnose sturgeon over a 10 year time period as a result of the proposed deepening project will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) for this species given that: (1) the population trend of shortnose sturgeon in the Kennebec River is increasing; (2) the death of 6 shortnose sturgeon represents an extremely small percentage of the number of shortnose sturgeon in the Kennebec River and a even smaller percentage of the species as a whole; (3) the loss of these shortnose sturgeon will not change the status or trends of the species as a whole; (4) the loss of these shortnose sturgeon is likely to have an undetectable effect on reproductive output of the Kennebec River population of shortnose sturgeon or the species as a whole; (5) and, the action will have no effect on the distribution of shortnose sturgeon in the action area or throughout its range.

Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five listing factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence. Recovery of a species occurs when listing it as an endangered or threatened species is no longer warranted. As explained above, the proposed action will not appreciably reduce the likelihood of survival of shortnose sturgeon. Also, it is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of shortnose sturgeon in any geographic area and since it will not affect the overall distribution of shortnose sturgeon other than to cause minor temporary adjustments in movements in the action area. The proposed action will not utilize shortnose sturgeon for recreational, scientific or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species, or affect the continued existence of shortnose sturgeon. The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction since the action will cause the mortality of only an extremely small percentage of the shortnose sturgeon in the Kennebec River and an even smaller percentage of the species as a whole and these mortalities are not expected to result in the reduction of overall reproductive fitness for the species as a whole. Therefore, the proposed action will not appreciably reduce the likelihood that shortnose sturgeon can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, resulting in the mortality of no more than 6 shortnose sturgeon over a 10 year time period, is not likely to appreciably reduce the survival and recovery of this species.

CONCLUSION

After reviewing the current status of the Kennebec River population of shortnose sturgeon and the status of shortnose sturgeon rangewide, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NMFS' biological opinion that the action, as proposed, is not likely to cause any reduction in the likelihood of survival and recovery in the wild of the Kennebec River population or the species as a whole and is therefore not likely to jeopardize the continued existence of shortnose sturgeon. No critical habitat has been designated for this species, therefore, none will be affected. NMFS also concludes that the proposed action is not likely to adversely affect the GOM DPS of Atlantic salmon and is therefore not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. Similarly, the action is not likely to adversely affect critical habitat designated for the GOM DPS of Atlantic salmon and therefore will not result in the destruction or adverse modification of this habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. NMFS interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered